AUSCULTATION AND PERCUSSION

LIBRARY OF CONGRESS.
RC76
Chap. .3
Shelf .B29
Copyright No.
UNITED STATES OF AMERICA.

A MANUAL

OF

AUSCULTATION AND PERCUSSION.

A MANUAL

OF

AUSCULTATION AND PERCUSSION.

BY

M. BARTH,

AND

M. HENRI ROGER.

TRANSLATED FROM

THE SIXTH FRENCH EDITION.

PHILADELPHIA:

LINDSAY AND BLAKISTON.

1866.

RC76
.3
.B29

Entered, according to Act of Congress, in the year 1866,

By LINDSAY & BLAKISTON,

In the Clerk's Office of the District Court of the United States for the Eastern District of Pennsylvania.

SHERMAN & CO., PRINTERS.

PREFACE.

HARDLY had auscultation been created by the genius of Laennec, than it was welcomed as one of the most precious discoveries by all those who are interested in the progress of medicine. The signal services that it renders to the science of diagnosis, cannot be called in doubt by whomsoever will take the pains to make himself acquainted with the working of the new method. The invention was too great not to strike impartial minds at once. The emulation to which it gave birth, the efforts that were afterwards made, either to give greater precision to its results, or to enlarge its domain, are a proof of its importance; and the extension which observers have given to it, the happy applications which have been made of it to the more exact and complete study of the diseases of the circulatory apparatus, to obstetrics and to surgery, testify

to the impulse which it has given to the whole science of medicine.

Nurtured by the study of the magnificent work of Laennec, we have for a number of years abandoned ourselves with ardor to the practice of auscultation; and after having displayed in *oral lessons* the principles of stethoscopy; after having taught its application at the bedside of the sick; we thought that a *book* would facilitate its study, and spread the knowledge of it. It has appeared to us useful to collect into a treatise the precepts of Laennec, the facts that he proved, and the new discoveries which have resulted from the labor of observers in all countries.

Besides, we have not limited ourselves to gathering up these scattered elements of science: being both of us hospital physicians, and devoted to clinic observation, we have added our own knowledge to the treatise, both by criticizing the facts of which auscultation is composed, and by some new discoveries.

In the study of the symptoms which come to the knowledge of the physician by the medium of hearing, we have taken care to establish the rules whose practice is of consequence to the exact perception of sensations; then we have

described the sonorous phenomena perceptible in the physiological and pathological conditions. Then having pointed out a single morbid sound, we have examined its characteristics, its differential diagnosis, its signification, and its semeiological value.

We desire those who are entirely novices in auscultation, to hold fast to this treatise at first, but afterwards, when their senses are more exercised, and their medical knowledge more extensive, to recur to its data, either to enlighten doubtful points, or to complete their first opinions.

In adding to the Compendium of Auscultation an *appendix*, in which we succinctly expose the principal ideas relative to *percussion*, we have not pretended, in so small a number of pages, to compose a treatise on plexímetry. But, as in practice the two methods are constantly assisting each other, we thought that to bring together their data, and to display their results, as it were, simultaneously, would facilitate the study of the physical diagnosis of diseases.

In closing, let us repeat what we have said before.

We have studied facts without preconceived opinions, without preoccupation of theories, and

without respect to persons; we have spoken them with sincerity; and when we have combated opinions which were in opposition to our own, we hope that we have done it with that decorum of language which belongs to scientific discussions. In everything we have had but one aim, utility; but one motive, the love of truth. We wish also to preserve our liberty of thought, convinced of the correctness of our opinions, and in the mean time ready to modify them if our own researches, or those of others, should prove to us that truth is to be found elsewhere. To change thus is to follow progress, and it is towards progress that all our efforts shall tend.*

* Extracted from the larger work of Messrs. Barth and Roger, "Traité Pratique d'Auscultation, &c. Paris. 1865."—*Trans.*

TABLE OF CONTENTS.

CHAPTER I.

Auscultation of the Respiratory Apparatus.

PAGE

Art. I.—The Respiratory Murmur, . . 13
§ 1. Normal Respiration, ... 13
§ 2. Changes in the Respiratory Murmur, . 14
1st. Changes in Intensity, ... 14
A. Strong or Puerile Respiration, . 15
B. Feeble Respiration, . . . 15
C. Respiration that is Null, . . 16
2d. Changes in Rhythm, ... 17
3d. Changes in Character, ... 18
A. Harsh Respiration, . . . 18
B. Bronchial or Tubal Respiration, . 19
C. Cavernous Respiration, . . . 20
D. Amphoric Respiration, . . . 21
§ 3. Changes by Anomalous Sounds, . . 21
First Kind—Rattling (Râles), . . . 23
1st. Vibrating Rattles, ... 23
2d. Blebby Rattling, ... 24
A. Crepitating Rattle, . . . 24
B. Subcrepitating Rattle, . . . 25
C. Cavernous Rattle, ... 27
Appendix, ... 28

PAGE

ART. II.—AUSCULTATION OF THE VOICE, . . 28
A. The Exaggerated Resounding of the Voice, or Slight Bronchophony, . 29
B. The Bronchial Voice, . . . 29
C. The Tremulous Voice, . . . 30
D. The Cavernous Voice, . . . 31
E. Amphoric Voice, ... 32

ART. III.—AUSCULTATION OF THE COUGH, . . 32
Metallic Tinkling, ... 34
Sound of Thoracic Fluctuations, . 35

ART. IV.—AUSCULTATION OF THE LARYNX, . 35

CHAPTER II.

AUSCULTATION OF THE CIRCULATORY APPARATUS.

ART. I.—AUSCULTATION OF THE HEART, . . 38
§ 1. Physiological Phenomena, . . . 39
§ 2. Pathological Phenomena, ... 41
1st. Changes of Seat, ... 41
2d. Changes in Intensity and Extent, . 42
3d. Changes in Rhythm, ... 43
4th. Changes in Character, . . . 45
5th. Anomalous Sounds of the Heart, . 46
First Kind—Sounds of Souffle, . . . 47
A. Soft Sound of Souffle, . . . 47
B. Sounds of Rasp, File, and Saw, . 55
C. Musical Sounds, Whistling, Whining (*piaulement*), . . . 56
Second Kind—Sounds of Friction, . . 57

PAGE

ART. II.—AUSCULTATION OF THE GREAT VESSELS, 58
1. Aortic Sounds, ... 59
2. Vascular Sounds, ... 62
A. Arterial Sounds, ... 63
B. Vascular Sounds, Venous and Mixed, ... 64

CHAPTER III.

AUSCULTATION OF THE ABDOMEN, . . . 65

CHAPTER IV.

AUSCULTATION OF THE HEAD, ... 67

CHAPTER V.

AUSCULTATION OF THE MEMBERS, . . . 69

CHAPTER VI.

OBSTETRICAL AUSCULTATION, ... 70
A. The Uterine Souffle, ... 70
B. Sounds of Displacement of the Fœtus, ... 71
C. Sounds of the Fœtal Heart, . . 71

CHAPTER VII.

DYNAMISM, ... 73

PAGE

PERCUSSION, ... 76
General Rules, ... 79
Division, ... 89

SEC. I. PERCUSSION OF THE CHEST, . . . 89

CHAPTER I.—PULMONARY APPARATUS, . . 89
§ 1. Especial Rules, ... 89
§ 2. Physiological Phenomena, . . . 91
§ 3. Pathological Phenomena, ... 95

CHAPTER II.—CIRCULATORY APPARATUS, . 111
Percussion of the Heart and the Great Vessels, 111
§ 1. Especial Rules, ... 111
§ 2. Physiological Phenomena, . . . 112
§ 3. Pathological Phenomena, ... 114

SEC. II. PERCUSSION OF THE ABDOMEN, . . 117
§ 1. Especial Rules, ... 117
§ 2. Physiological Phenomena, . . . 119
§ 3. Pathological Phenomena, . . . 122

SEC. III. PERCUSSION OF THE HEAD, THE NECK, THE SPINE, AND THE MEMBERS, . 150

PERCUSSION AND AUSCULTATION COMBINED, . 152

MANUAL OF

AUSCULTATION AND PERCUSSION.

Chapter I.

Auscultation of the Respiratory Apparatus.

The auscultation of the respiratory apparatus is exercised upon the thorax, and upon the laryngo-tracheal tube; it has for its object, the study of three orders of phenomena, furnished by the respiratory murmur, the voice, and the cough.

ART. I.

THE RESPIRATORY MURMUR.

§ 1. Normal Respiration.

If, in the physiological state, the ear is applied to the breast of a person breathing, there is heard a light murmur, analogous to that which is produced by a person sleeping peacefully, or heaving a deep sigh; this is the

natural respiratory sound, or the vesicular murmur. Soft and mellow to the ear, it is composed of two distinct sounds, that of inspiration, which is more intense and more prolonged, and that of expiration.

The vesicular murmur is strongest in those points which correspond to a greater thickness of the lungs; it is a little more harsh towards the roots of the bronchi (normal bronchial respiration). Equal on both sides, in those points which correspond to each other, it is in some persons a little more intense at the top of the right lung. More loud when the respiration is full and rapid; its force is also increased in children (puerile respiration); on the contrary it is weaker in the old. Generally its intensity increases in proportion as the chest is large, and its walls are thin.

§ 2. Changes in the Respiratory Murmur.

These may be divided into four classes,— 1st. Changes in intensity; 2d, in rhythm; 3d. in character; 4th, alteration by anomalous sounds.

1*st. Changes in Intensity.*

Considered under this point of view, respiration may be either strong, feeble, or null.

A. *Strong or Puerile Respiration.*—This consists of a vesicular murmur, whose intensity is greater than in the normal state, preserving however the soft and mellow character of the respiration. It announces not so much a lesion in the pulmonary organs, in that point at which it is heard, as disease in a portion more or less distant, the healthy parts in this case supplying the inaction of the affected parts.

B. *Feeble Respiration.*—This is characterized by a diminution in the normal force of the vesicular murmur, the latter preserving at times its natural softness, at times becoming a little more harsh. This proceeds either from the sound being transmitted less completely to the ear, or being produced with less intensity.

In the first case, this feeble expiration may be caused by pleuritic effusions, by thick pseudo-membranes deposited upon the pleuræ, or by tumors, which remove the lung from the walls of the thorax.

In the second case, its causes will be recognized as pleurodynia, contractions of the larynx, partial obstruction of one or more of the bronchial branches by a mass of mucus, or by a foreign body; the narrowing of their

cavity or the compression of their walls by tumors. It is also met with in pulmonary emphysema, and in the first degree of phthisis.

Of all the diseases that we have just enumerated, and which are often made known by a feeble respiration, tubercles, pulmonary emphysema, and liquid effusions within the pleura being much the most frequent (bronchitis, which is also common, has its own especial rattling), the physician ought to devote his attention almost exclusively to these. If the feebleness of the vesicular murmur coincides with an exaggerated sonorousness of the thorax, there is emphysema; with dulness, there are tubercles or there is pleural effusion. If feeble respiration, accompanied by dulness, is limited to the top of the lung, there are probably tubercles; if it is circumscribed below, there is probably pleuritic effusion; if it exists at the two apexes, there are almost certainly tubercles of the two sides; if it exists at the base of the two lungs, there is double pleurisy, or rather double dropsy of the chest.

C. *Respiration that is Null.*—We say that the respiration is null when the ear, applied to the chest, hears absolutely nothing; the vesicular murmur is also wanting, and no

sound takes its place; the silence is complete.

Respiration that is null is governed by the same physical conditions as feeble respiration, consequently it announces the same diseases, with this difference, that it indicates more decided anatomic lesions. But the complete silence of the respiratory murmur being nearly exceptional in emphysema and in tubercles; the diseases of the larynx revealing themselves by especial phenomena; the obliteration of the bronchi, their obstruction by foreign bodies, as well as pneumothorax without perforation, etc., being rare affections in comparison with liquid effusions within the pleura, it results from these facts, that respiration which is null is a symptom of very great value, a frequent indication of these effusions, and, as most frequently, pleurisy is single, and dropsy of the chest is double, it follows that the silence of the respiratory murmur, declared by a single side of the chest, almost certainly announces pleurisy with effusion.

2*d. Changes in Rhythm.*

Respiration which is changed in rhythm, may be slow (from twelve to seven inspira-

tions in a minute) as in many diseases of the cerebro-spinal apparatus, or frequent (from 30 to 80) as in a great number of thoracic or abdominal affections. Sometimes it is jerky, in asthma, in pleurodynia, at the commencement of phthisis, in chronic pleurisy with adhesions, etc.

Sometimes it is long, sometimes short; finally at times there is prolonged expiration, and then almost always the respiratory sound is at the same time more harsh.

Of these different changes, the last alone is of importance in diagnosis. We may say that prolonged expiration is the indication of two diseases alone: pulmonary emphysema, or tubercles at the stage of formation. In some cases, it is the first or only stethoscopic symptom of phthisis.

3d. Changes in Character.

A. *Harsh Respiration.*—This displays various degrees of force, of harshness, of dryness, and these changes affect both expiration and inspiration, or either alone.

It is met with in emphysema of the lung, at the commencement of phthisis, finally in all cases where there is pulmonary induration (melanosis, chronic pneumonia, etc.) Of all

these diseases emphysema and phthisis most frequently produce harshness in the respiratory sound. If this harshness is joined to dryness, coincident with hollowness and exaggerated sonorousness of the thorax, it indicates pulmonary emphysema; if harsh respiration is accompanied by a sound of prolonged expiration, if it is limited to the top of the chest, with resonance of the voice, and dulness on percussion, we must diagnosticate newly formed tubercles.

B. *Bronchial or Tubal Respiration.*—Remarkable at once for an augmentation of intensity, and a more elevated tone, bronchial respiration is well imitated by inhaling and exhaling through the hand, when rounded to a tube, or through the stethoscope; the more swiftly and forcibly we breathe, the more nearly we approach the tubal breathing.

When it is slightly marked, bronchial respiration differs but little from harsh respiration, of which it is but an exaggeration. When well defined, it has a peculiar tone —tubal—which serves to distinguish it from cavernous respiration, which generally has a hollow character peculiar to itself.

Bronchial respiration may be heard in a great number of affections of the pleuræ, of

the bronchi, and especially of the lungs, such as inflammatory hepatization, considerable agglomeration of tuberculous matter, extended pulmonary apoplexies, etc.; liquid effusions of the pleuræ, various tumors compressing the lung; finally, uniform dilatation of the bronchi, with hardening of the surrounding tissue.

Of all these diseases, the most frequent are pulmonary phthisis, pleurisy, and pneumonia.

If this bronchial respiration is but little marked, circumscribed at the top of the thorax, and supervening on a chronic disease, it should be attributed to the presence of newly formed tubercles in the parenchyma of the lung. If the bronchial murmur is more intense, if it shows itself in an acute affection of the chest, we can only think of pleurisy or pneumonia; if it is proportioned neither to the intensity nor to the extent of the dulness of the thorax, it is rather the indication of pleuritic effusion; if, on the contrary, it is intense, truly tubal, and if it is perceived in the whole extent of the dulness, there is reason to believe in the existence of pulmonary hepatization.

C. *Cavernous Respiration.*—This resembles the sound which is made by breathing into

a hollow space. It is imitated by inspiring and expiring with force into the two hands, placed in the form of a cavity. Its habitual seat is in the top of the chest.

It announces the dilatation of a bronchus into a somewhat voluminous cavity, or the existence of a cavern, properly speaking. But on account of the rareness of bronchial dilatations and of pulmonary excavations following abscess, gangrene, etc., compared to the frequency of phthisis, we may conclude that, nine times in ten, cavernous respiration will indicate a cavern resulting from the softening of tubercles.

D. *Amphoric Respiration.*—This is a resounding noise, a metallic tone, which is well imitated by blowing into a hollow pitcher, or into a decanter with resounding sides. It coincides almost always with the metallic tinkling. Well-marked amphoric respiration indicates almost infallibly pneumothorax with pulmonary fistula. Ill-defined, it may announce the same disease, but be the symptom also of a vast cavern, almost always tuberculous.

§ 3. Changes by Anomalous Sounds.

Anomalous sounds are of two kinds,—rattling and the sound of friction.

First Kind.—Sound of Friction.

Pleuritic Friction.—The two leaves of the pleura, in their normal condition, glide upon each other in silence during the motion of the lungs; but when certain pathological conditions are met with, there is a friction accompanied by noise. Pleuritic friction, somewhat analogous to the rubbing of parchment more or less dry, is generally jerky, and as if composed of several successive crackings. It presents varieties of harshness and of intensity, which has been the cause of admitting two varieties—a gentle friction, or grazing, and a harsh friction or scraping. When it is very strong, it may be felt by the hand applied to the thorax; at times the patient himself can feel it. In order to produce the sound of friction, the leaves of the pleura, or at least one of them, must present asperities, and they must glide upon each other in the motion of raising and depressing the ribs. These asperities depend almost always on the presence of false membranes, deposited on the surface of the pleuræ.

We meet with pleuritic friction in pleurisy, in certain cases of tubercles of the pleura, without adhesions, in some other organic

changes of this membrane, and very rarely in some varieties of pulmonary emphysema; but most frequently this phenomenon indicates pleurisy in process of cure. If it were heard exclusively at the top of the chest, we might suspect tuberculous pleurisy.

Second Kind.—Rattling. (*Râles.*)

Rattlings are anomalous noises formed during the act of breathing by the air, as it traverses the air-passages. They mix with the respiratory murmur, and obscure it, or completely replace it. We divide them into two groups: the first called dry, or vibrating, because they consist only of variable sounds; the others humid, or blebby, because they are caused by blebs.

1st. *Vibrating Rattles.*—We comprehend under this name the two principal varieties of the sonorous rattle, the acute or sibilant sonorous, and the grave or snoring sonorous. The first consists of a whistling, more or less acute; the second is characterized by a graver musical sound, which resembles the snoring of a man asleep, or, rather, the sound which a base chord gives under the finger. Often united, at times they alternate and displace each other.

The sonorous rattle may be heard in a great number of diseases, such as pulmonary emphysema, phlegmasy, or catarrh of the bronchi, and the compression of these conduits by tumors situated within the passage. These morbid states are various, but they all have a common element,—namely, the momentary or permanent contraction of one point or another in the air-passages.

By reason of the frequency of bronchial catarrhs, and the comparative rareness of other morbid conditions, in which snoring or whistling can manifest themselves, the sonorous rattle announces almost certainly a state of inflammation, or of fluxion in the bronchi.

2d. *Blebby Rattling.*—This comprehends the crepitating, the subcrepitating, and the cavernous.

A. *Crepitating Rattle.*—The crepitating or vesicular rhonchus presents to the ear the sensation of a fine and dry crackling, analogous to the sound which is produced by salt when made to crackle by a gentle heat in a basin, or to the sound which is heard on pressing between the fingers a lamina of aerated lung. Its blebs, perceived exclusively in inspiration, are very small, very numerous,

equal in volume, and a little dry. Its seat of predilection is the posterior and inferior part of the chest, on a single side.

The crepitating rattle is found in pneumonia, in certain forms of pulmonary congestion, in œdema, and in apoplexy of the lung.

By reason of the extreme frequency of inflammation of the lung, opposed to the comparative rarity of œdema and of apoplexy, the crepitating rhonchus—above all, when its characteristics are very decided—is the almost pathognomonic symptom of pneumonia, at the period of choking (*engouement*).

B. *Subcrepitating Rattle* (*mucous, bronchial, humid*).—The subcrepitating has been justly compared to the sound which is perceived by blowing with a straw into soapsuds. The varying volume of its blebs must distinguish it into fine, middling, and coarse subcrepitating; the number of the blebs and their character are equally variable. The rattle accompanies both inspiration and expiration, and its place of election is the inferior and posterior part of the chest, on both sides.

The subcrepitating rattle may be perceived in a number of diseases, such as bronchitis in the second stage, different kinds of catarrh of the pulmonary mucous membrane, the

dilatation of the bronchi with supersecretion, certain forms of pulmonary congestion and apoplexy, and phthisis at the beginning of the softening of the tubercles.

Of all these affections, the two most frequent are bronchitis, and tubercles at the beginning of the softening stage. The manifestation of the subcrepitating rattle will cause us then to think first of those two diseases, and it is the knowledge of the seat of predilection of the rhonchus which will guide the diagnosis. If the blebs, being very numerous at the base of the two lungs, diminish as the ear of the observer approaches the top of the chest, the existence of bronchitis is almost certain; if, on the contrary, being absent or scarce at the base of the thorax, they are heard above, especially on a single side, and become more and more evident and numerous as we rise in auscultating, we must diagnosticate tubercles at the softening stage.

In certain cases of bronchitis complicated with pleurisy, accompanied by compression of the more flexible parts of the lung, the humid rattling, perceived at the middle and posterior regions of the chest, assumes sometimes the character of a true gurgling, capable of making us infer serious lesions, but

which disappears by degrees without leaving any traces. In other analogous cases, with more considerable pressing back of the lung, there is heard at times under the clavicle a humid rattle with great blebs, which would cause us to believe in the presence of pulmonary cavities, but which depends in reality only on bronchial mucus collected in the branches of the superior lobe.

C. *Cavernous Rattle* (gurgling).—This rattle is formed by blebs, very numerous, large, and unequal, and mixed with cavernous respiration; it is this mixture which forms its distinctive character. Perceived in inspiration and expiration, it is generally circumscribed at the top of one of the two lungs. Sometimes the rhonchus, while seated in the superior portion of the chest, has very small blebs, with a clearer tone, unmixed with cavernous respiration. This is the cavernulous rattle.

The cavernous rhonchus announces the existence of a pulmonary excavation, or of a neighboring abscess, communicating with the bronchi, or, perhaps, bronchial dilatation. If it coincides with the cavernous voice and has its seat at the apex of the lung, it is the almost certain indication of tuberculous excavation.

APPENDIX.

There are still several anomalous sounds different from the preceding, and giving to the ear the sensation of rubbing, of a plaintive cry, or of the clapping of a valve. These phenomena, which are rare, are generally connected with pulmonary excavations.

A final sound, much more important, consists of a series of small crepitations, at first dry, afterwards humid, and which, being generally perceived at the top of the chest, are one of the most characteristic symptoms of tubercles about to soften.

ART. II.

AUSCULTATION OF THE VOICE.

If we auscultate upon the larynx of a person speaking, the vocal sounds resound with noise under the stethoscope, and strike the ear with force. Along the trachea this reso-

nance is a little less grave and less intense, and upon the chest we hear only a confused hum (*bourdonnement*). The natural resonance of the voice which represents exactly all the varieties of the voice itself, is as much more intense as the latter is stronger, and more sonorous, as we auscultate nearer the great bronchial tubes, and as the chest is larger and its walls more thin; equal on both sides in corresponding points, it is a little more marked towards the apex of the right lung, because of the greater diameter of the principal bronchial tube upon this side.

In the pathological state at times the vocal resonance is only exaggerated, again it suffers at the same time modifications in nature, and the voice becomes bronchial, tremulous, cavernous, amphoric.

A. *The exaggerated resounding of the voice*, or *slight bronchophony*, is characterized by a resonance of the voice a little stronger than is natural, and it is only one degree less than the bronchial voice, true bronchophony. It is connected with changes generally similar but less extensive or less marked.

B. *The bronchial voice* is a resonance much stronger than is normal; it is remarkable for its intensity, its extent, its fixedness, its per-

manence. It almost always coincides with the bronchial respiration. It may be verified in dilatation of the bronchi, in pleurisy, and above all in induration of the lung. But on account of the rarity of dilatation of the bronchi, it is almost always pulmonary induration which is announced by bronchophony. Now of all the changes in which the density of the lung is augmented, pneumonia and tubercles are incomparably the most frequent. The conditions of the bronchial voice being better fulfilled in pneumonia than in tubercles, this voice is more decided in the former disease than in the latter; it scarcely exists except in certain cases of pleurisy, and if at that time it is strong and extensive, we may infer that the pleuritic effusion is complicated by pneumonic or tuberculous induration.

C. *The tremulous voice* (ægophony) is a peculiar resonance when the voice takes a harsher tone, and becomes more tremulous and jerky. At times it sounds as if the patient spoke with a counter placed between the teeth and the lips (Polichinello voice). It is usually heard on a single side in the inferior half of the infra-spinata fossa, and when it occupies a more considerable extent, it is in this point still that it is the most decided; it may change

its seat in different positions of the patient. It coincides almost always with the weakness or absence of the vesicular murmur at the base of the chest.

True ægophony announces a pleural effusion, which is almost always serious. If it is perceived on one side alone, with coincidence of fever, there is pleurisy; if on both sides, without fever, and with general dropsy, there is hydrothorax. If it appears in the course of a phlegmasy of the pulmonary parenchyma, and if besides, it changes its place as the patient changes his position, it indicates pleuro-pneumonia.

D. *The cavernous voice* (pectoriloquy).—The voice is cavernous, if it seems to us, in auscultating a speaking patient, that the vocal vibrations are concentrated into a hollow space, whose walls return the sounds to the ear, more or less distinctly articulated.

It is generally circumscribed at the superior part of the chest, and coincides either with the cavernous rattle, or, especially, with cavernous respiration.

Cavernous voice, like cavernous breathing, indicates the existence of bronchial dilatation of tuberculous, purulent, apoplectic, or gangrenous excavation.

From the rarity of bronchial dilatations, and of pulmonary excavations, independent of phthisis, compared to the frequency of caverns in consumptive patients, we conclude that nine times in ten, cavernous voice announces tuberculous excavation.

E. *Amphoric voice* is characterized by a resonance entirely similar to the metallic and cavernous hum which is produced in speaking through the neck of a great pitcher three-quarters empty. It usually coincides with amphoric respiration, and announces, like it, pneumothorax, and more rarely, a vast pulmonary excavation.

ART. III.

AUSCULTATION OF THE COUGH.

If the ear be applied to the chest of a healthy man, we perceive when he coughs, a dull and confused sound, accompanied by a concussion which shakes the pectoral cav-

ity. This phenomenon, compounded of impulsion and of noise, is more perceptible as it passes nearer the ear, and in the more voluminous bronchial tubes, and when the patient coughs with more force. The cough heard upon the larynx and trachea, and, in subjects with a narrow chest, at the root of the bronchi, is somewhat cavernous, and gives the sensation of the rapid passage of air into a tube. In the pathological state, the cough offers especial characteristics; it is bronchial or tubal, cavernous, amphoric.

When the cough is tubal, the ear feels the sensation that would be given by a column of air, traversing with much noise, force, and rapidity, tubes with solid sides. It shows itself under the same conditions as bronchial respiration, and above all, is connected with pulmonary hepatization.

The cavernous cough consists of a resonance, stronger and especially more hollow than that of the normal cough. It is accompanied by an impulsion against the ear which is entirely characteristic. It is one of the most positive symptoms of a pulmonary cavity.

The amphoric cough is characterized by a very distinct metallic resonance; it announces, when joined to the amphoric respi-

ration and voice, the existence of pneumo-hydrothorax, or of a vast pulmonary excavation.

METALLIC TINKLING.

This name is given to a little silvery sound, single or multiplied, similar to the sound which is produced by letting one or more grains of sand fall into a metallic cup. It accompanies the respiration and voice, but it is generally more distinct during the cough. It announces the existence either of a very great pulmonary cavern, or of pneumothorax, or of hydropneumothorax, with or without fistulous perforation of the bronchi.

Because of the rarity of caverns sufficiently spacious to cause this phenomenon, the metallic tinkling, when it is well marked, is almost always the indication of pneumothorax. As the gaseous effusions of the pleura rarely exist without liquid collection, or without pulmonary perforation, if the tinkling is produced constantly and distinctly, by respiration and by the voice, it is a pathognomonical symptom of hydropneumothorax, with fistulous communication of the pleura and bronchi.

SOUND OF THORACIC FLUCTUATION.

In the physiological state succussion causes no noise in the chest; it is the same in simple liquid effusion of the pleura; but when there is a simultaneous collection of liquid and of air, the collision of these fluids, determined by blows upon the trunk, or by the spontaneous motions of the patient, causes the ear to hear a rattling perfectly like the sound produced by shaking a decanter half full of water. At times this phenomenon is so decided that we hear it at a distance; it almost always accompanies amphoric respiration and metallic tinkling, and it indicates, like them, the existence of pneumothorax, or of a very large pulmonary cavern half full of liquid.

ART. IV.

AUSCULTATION OF THE LARYNX.

In the normal condition, in the larynx, the respiratory sound has a hollow and cavernous tone, the vocal resonance is at its maximum,

and the cough gives the sensation of the rapid passage of air through a hollow space.

In the pathological condition, the laryngeal respiratory murmur is more harsh, more rasping, as in the case of acute or chronic laryngitis; or indeed it is replaced by a whistling, in spasm or œdema of the glottis, in stridulous laryngitis, and in some cases of foreign bodies, and of compression of the trachea; or by a sonorous cry in cases of laryngeal ulcerations with decided tumefaction of the edges and obstacle to the passage of air, or still again by a snoring in simple or stridulous laryngitis, in ulcerations, laryngeal vegetations, etc., a snoring which in croup, has often a metallic tone.

In some circumstances, the ear perceives a cavernous laryngeal rattling, when, for example, the trachea and the larynx are filled with mucosities; this rattle may be more circumscribed and be connected with the presence of mucosities upon an ulceration or around a foreign body, arrested in the ventricles, etc. Finally, in rare cases, we perceive a tremulousness (*tremblotement*), which announces the existence of croup, with false floating membranes.

There is another symptom which is met

with in a great number of diseases of the larynx, which although verified by auscultation of the chest, ought to be mentioned here; it is the diminution or complete abolition of the vesicular murmur. This phenomenon is connected with every alteration which introduces a notable obstacle to the introduction of air into the air-passages, whether it obstructs or contracts the diameter of the conduits (swelling, pseudo-membranes, vegetation, accidental productions, foreign bodies, etc.), whether it compresses them from without inward (cancerous tumors, cysts, aneurisms, etc.), finally whether it produces more or less complete occlusion of the superior orifice of the aeriferous tube (hypertrophy of the tonsils, polypus of the nasal fossæ falling back on the superior part of the larynx, etc.).

Chapter II.

Auscultation of the Circulatory Apparatus.

This comprehends the auscultation of the heart, and of the great vessels.

ART. I.

AUSCULTATION OF THE HEART.

§ 1. Physiological Phenomena.

In the natural condition, if we apply the ear to the præcordial region, we hear a species of tick-tack, composed of two successive sounds, which are regularly repeated sixty to eighty times a minute.

The first of these sounds, dull, profound, and more prolonged than the second, coincides with the striking of the point of the heart against the thorax, and immediately precedes the radial pulse; it has its maximum of intensity between the fourth and the fifth rib, below and a little outside of the left nipple. The second, clearer, shorter, and

more superficial, takes place after the pulsation of the arteries, and its maximum of intensity is nearly at the level of the third rib, a little below and to the right of the nipple.

Considered in their rhythm, the sounds are repeated in the following order: at first the dull sound, then the small silence, afterwards the clear sound, and finally the great silence; every pair, with the intermediate silences constitutes a complete beat. The beats, numbering from sixty to eighty in the adult, are more frequent in infancy; and are also accelerated by exercise, the moral emotions, etc. The force of the sounds varies according to the energy and rapidity of the contractions of the heart, and the idiosyncrasy of individuals, and the physical disposition of the thorax: they are more intense in nervous subjects, with narrow and thin chests, etc. Their extent is equally variable: distinct in the præcordial region, they weaken by degrees as we remove from this centre; they are still perceived with considerable facility, on the right side in front; they are less so on the left side at the back, and with difficulty on the right side posteriorly. They vary also in extent according to the condition of the surrounding organs, which conduct the

sounds with greater or less facility. Their tone offers several different shades; but they are otherwise clear, and present nothing harsh or rasping to the ear.

The mechanism of these sounds has been explained with much diversity. Here are the conclusions to which reason and experiment have guided us, and which cardiography has put beyond all kind of doubt.

The series of movements of the heart begins with the contraction of the auricles; immediately after comes the contraction of the ventricles, to which succeeds their diastole.

The shock of the heart, and consequently the dull sound, coincide with the ventricular contraction and the diastole of the great arteries; the second sound corresponds with the dilatation of the ventricles and with the systole of the arteries near the heart.

The first sound is produced at once by the muscular contraction of the ventricles, by the shock given to the inferior face of the sigmoidal valves, and to the pulmonary and aortic base of the sanguineous columns by the clapping of the auriculo-ventricular valves, and by the impulsion of the point of the heart against the thorax.

The second sound is due above all to the

clapping of the sigmoidal valves, and to the shock in return, upon their concave face, of the sanguineous columns thrown into the aorta and the pulmonary artery.

§ 2. Pathological Phenomena.

In the morbid state, the sounds present various alterations, as regards their seat, their extent, their intensity, their rhythm, and their tone; they may also be preceded, accompanied, followed, or replaced by anomalous sounds.

1*st. Changes of Seat.*

Sometimes the sounds of the heart are displaced, and their maximum no longer corresponds with the points that we have indicated. These displacements may depend on lesions of the heart, of the pericardium, of the great vessels, or of the surrounding organs.

The depression of the two sounds may be due to tumors situated at the base of the heart, and which depress it, or to hypertrophy with dilatation of the auricles; their elevation, to the diaphragm being pressed back from below upwards; their lateral displacement, to liquid or gaseous effusions in the pleura; their displacement backwards to tumors of

the anterior mediastinum. Morbid adhesions of the heart to the pericardium, rickety deformities of the thorax, general or partial hypertrophies, may also displace the sounds in different ways.

2d. Changes in Intensity and Extent.

In certain circumstances the sounds of the heart are only heard in the præcordial region, and besides are scarcely appreciable, so weak are they or so badly transmitted to the ear. At other times, on the contrary, they are strong and loud; the ear, raised to the region of the heart by the energetic contractions of that organ, perceives the two sounds very distinctly at all points of the thorax, at times even at a distance, so great is their intensity, or so perfect is their transmission.

A diminution in the extent and force of the sounds may depend on atrophy of the heart, on concentric hypertrophy, on softening, or on a condition of local atony or of general weakness, or yet again on the existence of an effusion in the pericardium, or on emphysema of the anterior edge of the left lung.

An increase of the extent and force of the sounds will depend, either on hypertrophy

with dilatation of the cavities of the heart, or on induration of the muscular tissue of its walls, either on nervous palpitations, on a state of general morbid excitability, or indeed on changes of the neighboring organs, such as pulmonary hepatization, tubercles, etc.

3d. Changes in Rhythm.

The sounds of the heart may be changed in their frequency, in their order of succession, and in the number of sounds which correspond with each beat.

Without speaking of the febrile state, in which the frequency of the pulsations may rise to 140 or 150 in a minute, there are certain grave affections of the heart in which they exceed this number; and sometimes they are so much precipitated that they can no longer be counted. As for the slackening of the pulsations, whose number may descend as low as 30, 20, and even 16, it is connected either with certain diseases of the encephalo-spinal system, or especially with the action of digitalis; it has likewise been noticed in cases of alteration of the aortic orifice, at times with softening or fatty degeneracy of the heart. The order of succession may be disturbed in

very different ways: sometimes the beats are precipitated and retarded alternately; sometimes they experience, at intervals, a stop whose duration equals that of an entire beat: this constitutes an intermission;—these disorders have not in themselves a very exact morbid significance. But at other times, the irregularity is such that the confused and tumultuous beats no longer preserve any measured time, and when this fact is permanent, it is rather the indication of various physical changes of the heart, among which comes in the first rank contraction of the mitral orifice.

At times, again, the disturbance is limited to one of the elements of the beats; thus, one of the silences (usually the great one) is more prolonged, which may depend on the difficulty that the blood finds in penetrating into the ventricles, when there exists an auriculo-ventricular contraction; or the prolongation affects one of the sounds (generally the first), as we observe in cases of hypertrophy with contraction of the arterial orifices.

As to the number of the sounds, sometimes one alone is perceived, as when the first is so much prolonged as to cover the second, which is scarcely observed except in cases where it

is transformed into an anomalous sound; at times, on the contrary, three sounds are heard: this phenomenon has been met with in some cases of contraction of the orifices; it has been thought that it might be attributed at other times, to the addition of a clapping produced by the hypertrophied auricle whose contractions are aphonous in the natural state; we have also noted a doubling of the second sound towards the close of some cases of pericarditis. The formation of four sounds is also connected with certain organic affections with contraction of the orifices. Finally, it is generally recognized that the cause of triple and quadruple sounds is a defect of synchronism in the motions of the right and left hearts, and oftener still they result from the addition of anomalous sounds.

4th. Changes in Character.

The sounds suffer many changes in relation to their tone; they are more clear or more dull than in the natural condition. The clear sounds may be referred to a thinning of the walls of the heart; the dull character of the sounds announces, on the contrary, a thickening of the valves, and oftener a hypertrophy of the walls themselves.

Some dry and hard sounds have seemed to coincide at times with a certain degree of thickening and rigidity of the valves; hoarse and deadened sounds have appeared to refer rather to a condition of softness or of expansion of these membranous veils.

The metallic tone (*metallic tinkling of the heart*), may depend on nervous palpitations, or on a gaseous distension of the stomach; it is connected at times with an induration of the ventricular walls, and in very rare cases, it may be due to the presence of pneumothorax.

Further, the sounds of the heart may lose their clearness, and become a little blowing or rasping. These changes in character signalize the first degree of various lesions in the valves and the orifices, lesions whose existence, in a more advanced stage, will be revealed by anomalous sounds.

5th. Anomalous Sounds of the Heart.

Anomalous sounds, that is those of which there exists no trace in the physiological condition, are divided into two kinds : the sounds of blowing or *souffle*, which are produced in the cavities of the heart themselves, and

the sounds of friction, which are formed outside of that organ, in the pericardium.

First Kind—Sounds of Souffle.

Under this denomination are comprehended the souffle properly speaking, or soft souffle, the sounds of the rasp, file, or saw, and finally musical sounds, such as whistling, whining, etc.

A. *Sound of Souffle* (*Bellows Sound*).—Of all the anomalous sounds this is the most common; its name itself is the best definition. More or less sweet to the ear, it is single or double, that is to say it can be perceived during the systole or diastole alone, or during both.

We meet the sound of souffle, 1st. In a great number of diseases with physical lesions of the heart, contractions of the orifices, changes in the valves (fibrinous deposits, vegetations, insufficiency, etc.); hypertrophy, with dilatation, endocarditis, etc.; 2d. In diseases with alteration of the blood (anemia, chlorosis); 3d. In diseases with nervous disturbance of the heart (palpitations, etc.).

If the sound of souffle shows itself in affections so numerous and so different, what

shall we do in order positively to understand its morbid signification? The problem to be first solved, is the following: A sound of cardiac souffle being given, is there or is there not organic lesion of the heart? In order to answer this first question, we must study by turns the tone of the sound, the time at which it shows itself, its persistence, its progress, and finally the whole of the concomitant phenomena.

The souffles which are connected with organic lesion of the heart, at times soft to the ear, are more often harsh, and approach the sounds of the rasp, the file, etc. On the contrary, the souffles in the absence of material lesions, are almost always very soft. The former accompany the first or second period of the heart; the latter are always in the first period, and never in the second. The former being permanent, last for months or years; the latter are generally intermittent and fleeting. In time, as the lesions of the orifices become graver and more profound, the former suffer gradual transformations from the soft souffle to the musical sounds; the latter habitually preserve their character of softness, whatever may be their modifications of intensity.

Finally, some are accompanied by local and

general symptoms characteristic of an affection of the heart; dulness, the purring tremor (*frémissement cataire*), irregularities of the pulse, considerable œdema of the inferior extremities, whilst none of these phenomena are seen in chlorosis or anemia, at least in a decided and durable manner.

To resume—the soft tone of the sound, its exclusive connection with the first period of the heart, its intermittence or its short duration, and the absence of a certain number of grave phenomena,—such are in general the characteristics of the souffle, which is independent of a physical lesion of the heart, whilst the souffle that indicates a material alteration of the organ usually has the opposite characters of harshness, of coincidence with the two periods, or with the second alone, of permanence, and of combination with other morbid conditions.

The existence of a physical lesion being admitted, the next point is to discover what is its nature. Now, the souffles which depend on pericarditis, on hypertrophy, on the formation of a clot in the cavities of the heart, are accompanied by particular signs, such as hollowness and dulness at the præcordial region, diminution in the stroke, with weak-

ness and distance of the sounds (pericarditis), dulness, increase of intensity of the sounds and of impulsion (eccentric hypertrophy), sudden manifestation of the anomalous sound, weakness of the arterial pulse (formation of clots). These lesions being removed from the diagnosis, there remains scarcely anything but the diseases of the orifices, and of the valves, and from the point of view of their principal effects, the latter may be arranged into two classes, contractions and insufficiencies.

How shall we discover whether there is contraction or insufficiency? In order to answer this question, we must first discover the period to which the anomalous sound belongs, to determine whether it precedes or accompanies the systole, or whether it coincides with the diastole of the heart, and the morbid signification of the souffle may be deduced by representing to oneself the acts which correspond with each of these motions.

If the morbid sound precedes the first normal sound of the heart, it takes place at the moment of the contraction of the auricles, and depends on an obstacle to the free passage of blood into the ventricles; the presystolic souffle is then the indication of a contraction of the auriculo-ventricular orifices.

If the anomalous sound coincides with the first sound, it corresponds to the systole of the ventricles, and may be due either to an obstacle which impedes the direct course of the blood through the aortic or pulmonary openings, or to some morbid condition which facilitates the reflux of this liquid into the auricles; the systolic souffle may then indicate either a contraction of the arterial orifices, or insufficiency of the auriculo-ventricular openings.

Finally, if the anomalous sound exists at the second period, it corresponds to the diastole of the heart, and is connected, in the immense majority of cases, with reflux of the blood into the ventricles; consequently, the diastolic souffle announces almost always an insufficiency of the sigmoid valves.

In cases of doubt, and especially of souffle at the first period, the exact pointing out of the diseased orifice will indicate the nature of the existing lesion.

If we specify that there exists, for example, a lesion of an arterial orifice, in a case where the souffle replaces the first sound of the heart, we shall consequently have diagnosticated an arterial contraction.

Now the seat of the disease will be recog-

nized by understanding the spot at which is produced the maximum of the souffle, and by this consideration—that it is transmitted to the great vessels, or that it does not extend beyond the region of the heart. In effect, the souffle due to lesion of the sigmoid valves has its maximum of intensity above the nipple, at the base of the heart, and is transmitted more or less to the great arteries, while the souffle due to an alteration of the auriculo-ventricular valves has its maximum below the nipple, nearer to the point of the heart, and is not transmitted to the great arterial trunks.

If, then, the souffle at the first sound has its maximum of intensity at the base of the heart, and is transmitted to the great arteries, it will be the indication of arterial contraction. This same souffle at the first sound, having, on the contrary, its maximum at the point of the organ, without transmission to the great arterial trunks, will indicate auriculo-ventricular insufficiency. Let us recollect here, that while recognizing that a souffle belongs to the first period of the heart, it is often very difficult to determine exactly whether it precedes, accompanies, or immediately follows the systole; we are then

obliged, in order to judge of its value, to discover whether it is transmitted to the aorta, or whether it remains circumscribed at the præcordial region. In the first case it indicates a lesion of the aortic orifice, which is always a contraction; in the second, this souffle at the first period of the heart signifies an alteration in the auriculo-ventricular orifice, which may be contraction of its contour or insufficiency of its valve.

As for the souffle at the second sound, as it is most frequently produced at the level of the arterial orifices, and almost never at the level of the auriculo-ventricular openings, we should, from the single fact of its presence, infer a change in the sigmoid valves; and if it be proved that it is transmitted to the great arteries, we cannot doubt that there is, in effect, arterial insufficiency. It follows that the diastolic souffle will very rarely be the indication of auriculo-ventricular contraction, and the latter lesion will be better recognized, as we have said, by the presence of presystolic souffle. Let us add, that very often this contraction is not revealed by any appreciable morbid sound.

After having determined the kind of diseased orifice, and the species of lesion by

which it is affected, there remains only to decide whether the alteration belongs to the right or to the left heart. We shall arrive at the solution of this problem by examining the relative seat of the anomalous sound of one half of the heart in comparison with the normal sounds of the other half. We know that conditions capable of producing souffles reside in both sides, and that thus one of the two sounds may be changed in the left heart and remain normal in the right heart, and reciprocally. If, then, for example, we heard on the left of any point whatever the maximum of an anomalous sound, whilst more to the right we found again the natural sound, we must conclude that the lesion and the souffle which reveals it belong to the left heart, and *vice versa.*

Besides, the diagnosis of diseases of the left cavities will be better confirmed by the existence of changes in the pulse, and that of affections of the right cavities, by disturbances in the circulation of the great veins, and especially of the jugulars.

Until this time we have supposed that there existed a single souffle in the præcordial region. Now let us admit that it may be double; this will indicate either a lesion of

two orifices, or a double lesion of the same opening, and the same considerations drawn from the seat of the souffle, from its propagation, etc., will still serve to determine what kind of combined lesions exists.

Let us add, besides, that the diseases of the valves which bring on contraction (such as thickening, induration of these membranous veils) are also often of a nature to cause their insufficiency. We must then conclude that a double sound of souffle will rather be the indication of a double lesion of a single orifice than of two lesions, the one seated at an arterial orifice, the other at an auriculo-ventricular orifice; and as the auriculo-ventricular contraction often exists without noise, the result is that a double anomalous sound, considered independently of the other elements of the diagnosis, will sooner indicate arterial contraction and insufficiency than any other kind of combined alteration; besides, as the diseases of the valves are much more frequent on the left than on the right, a double sound of souffle will usually announce contraction of the aortic orifice with insufficiency of the sigmoid valves.

B. *Sounds of the Rasp, File, and Saw.*—These anomalous sounds, which their name describes

with sufficient exactness, often replace the first sound of the heart; at times they are double, and cover the second as well as the first sound. They are permanent, and generally never disappear after they are well established; it is more common to find them, on the contrary, transformed afterwards into musical sounds. They are almost always accompanied by a vibratory shuddering, *purring tremor*, perceptible to the hand.

They announce almost constantly organic changes of the orifices of the heart, and more frequently contractions than insufficiencies. Their character of harshness indicates, in general, a greater friction, and consequently more decided lesions than those which are pointed out by simple sounds of souffle; these are generally cartilaginous or osseous indurations, calcareous deposits, etc.

C. *Musical Sounds, Whistling, Whining (piaulement).*—These are sounds compared to whistling, cooing, or to the sibilant rattle of bronchitis. Most frequently these sounds are but the more elevated degree, the more acute tone of the sounds of souffle, and indicate nearly the same physical conditions in their extreme stage. In effect, they are connected with profound lesions of the valves, and prin-

cipally with considerable contractions of the aortic orifice, caused by calcareous deposits, and by the ossiform degeneracy of the sigmoid valves.

The musical sounds of the heart have been verified exceptionally, in simple hypertrophies with dilatation of the ventricular cavities. They may even be produced independently of every physical lesion of the organ, in changes of the blood, such as chlorosis; but it is when this affection is superimposed on a valvular lesion, that it will especially tend to give the musical character to a cardiac souffle.

Second Kind—Sounds of Friction.

Pericardic Friction.—Under the generic name of sound of friction of the pericardium are designated several phenomena, which present considerable analogy to the varieties of pleural friction, and which recognize as their cause similar anatomical conditions. Thus we distinguish a soft friction or grazing, and a harsh friction or creaking, like the sound of new leather, which imitates the creaking of a new sole under the motions of the foot; at times it is a scraping, more or less analogous to the sound of the rasp.

The sound of friction points out either the existence of pericarditis with false membranes, and coincidence of a little liquid, or the presence on the anterior face of the heart of certain consecutive changes. Grazing denotes that the pseudo-membranous exudation is recent, soft, thin, and scarcely rugose. The harsh friction (the sound of new leather), announces that the pseudo-membranes are older, thicker, unequal, resisting. Finally the sound of scraping is connected with the formation of harder morbid products, such as cartilaginous or osseous plates in the pseudo-membranes, osteo-calcareous laminæ developed in the parietal pericardium, or yet again, solid concretions lodged among the fibres of the heart and making leaps under the serous membrane which clothes it.

ART. II.

AUSCULTATION OF THE GREAT VESSELS.

Let us study in succession the sounds that are furnished by the aorta, the arteries, and the veins.

In the normal state, we hear, under the pas-

sage of the thoracic aorta, two sounds which the ear cannot distinguish from those of the heart, and along the ventral aorta, we perceive no longer any sound but a single one corresponding to the diastole of the vessel. On the arteries in the neighborhood of the heart, we hear in the same manner two sounds; on those which are more distant we perceive only a single one, which grows weak as we auscultate farther from the centre of circulation. Finally, on the veins, the ear does not seize the trace of any sound. In the pathological condition, anomalous sounds are produced in these various parts of the vascular system.

1. AORTIC SOUNDS.

In diseases of the aorta, auscultation reveals sometimes a single sound, constituted either of a sound of souffle, of the rasp, or of the saw, or by a rattling more or less prolonged; sometimes a double sound analogous to that of the heart, or indeed, a double souffle, or finally a clapping preceded or followed by a souffle. Of these various sounds, some are

only the transmission of those which pass in the heart; the rest are intrinsic sounds.

Generally, the morbid sounds are double on the thoracic aorta, and simple upon the abdominal aorta. They may point out numerous lesions, either of the orifice of the aorta itself, such as contractions or insufficiencies; or of the interior of the vessel, such as pseudo-membranous, cartilaginous deposits; calcareous, ossiform incrustations; erosions of the inner coating; contractions; dilatations; aneurismal sacs or varicose aneurisms.

The symptoms of contractions, and of insufficiencies of the aortic orifice having already been shown, let us here only recall the phenomena proper to diseases of the vessel itself.

A harsh souffle, or grating sound, perceived exclusively on the passage of the aorta, over a great extent, reveals the existence, on the internal surface of the vessel, of rugosities which depend on recent pseudo-membranes, if there is fever; and on cartilaginous or calcareous plates, if there is coincident apyrexia, above all in an old person whose radial artery presents ossifications. A soft souffle, perceptible over the whole passage of the pectoral artery, would rather be a symptom of chloro-

anemia, if it coincided with an analogous sound in the vessels of the neck. An aortic souffle limited to a small extent might make us suspect local contraction of the vessel, especially if there were simultaneously verified energetic pulsations of the arteries springing above the constricted portion.

A sound of souffle or grating perceived at the first period, behind the sternum, with dulness at the same point and purring tremor (*frémissement cataire*), without tumor, is the indication of a dilatation of the ascending aorta; and if this sound were followed by souffle at the second period we might infer from it that there is also insufficiency of the aortic valves.

A systolic souffle and a diastolic shuddering (*bruissement*) independent of the sounds of the heart, which remain natural, would render probable the existence of an aneurismal abscess into which the blood enters, and from which it goes out with noise. The diagnosis would be more sure if to the stethosopic phenomena are joined dulness, vibratory shuddering, and impulsion; and there will no longer remain any doubt, if we see a pulsating tumor appear at the same point. A double clapping, analogous to the double sound

of the heart, having its maximum of intensity on a line with a tumor, agitated by movements of less manifest expansion, would give rise to the idea of an aneurismal sac filled with clots. Finally, an intense prolonged shuddering perceived independent of the sounds of the heart, on one of the points where the aorta is in connection with the venous system, would announce the existence of a varicose aneurism of the aorta.

Upon the ventral aorta the same morbid sounds (generally simple), such as single exaggerated beating, the sound of souffle or of the rasp, shuddering (*bruissement*), will have a similar pathological signification, as far as they coincide with the other phenomena mentioned above.

Finally, there is found at times upon the abdominal aorta an exaggeration of its normal beating, without the existence of any physical lesion: these beatings reveal the morbid state pointed out by Laennec under the name of palpitations of the aorta.

II. VASCULAR SOUNDS.

The greater part of the anomalous sounds produced at the orifice of the aorta, or in its

passage, may be heard even in the arteries which spring from it; but besides these phenomena of transmission, there are pathological sounds whose source is in the arteries themselves; others are produced more especially in the veins; finally, some result from the combination of arterial and venous sounds.

A. *Arterial Sounds.* There is heard over the passage of the arteries, at times, an intermittent souffle, soft to the ear, coinciding with the diastole of the vessel, perceived most frequently, on many arteries at once, but oftenest on the carotids, and more common in the right than in the left. At times the souffle is more harsh: it is a true rasping sound, more rarely generalized, and usually accompanied by a shivering perceptible to the hand. At other times it is a shuddering, more prolonged, more acute, usually limited, and coinciding also with a manifest vibratory shivering.

In general the more harsh and circumscribed the sounds are, the more certainly do they announce a physical lesion of the artery: contractions of its cavity, rugosities of its internal surface, aneurismal dilatations, compression by tumors, etc.;—continued

shuddering is more particularly met with in arterio-venous communications.

On the contrary the more soft and generalized are the souffles, the more do they announce a change in the entire economy, disease of the blood, and particularly, chlorosis and anemia.

B. *Vascular Sounds, venous and mixed.* The sounds that we collect under this title are generally continuous, and offer various shades of tone and of character. At times it is a dull, diffuse murmur, like that which is heard when we put to the ear a great univalve shell (*continuous simple murmur*). Sometimes it is a more intense murmur, continuous like the preceding, but reinforced at each systole of the heart, and which gives the sensation of two currents running counter to each other (*sound of souffle with a double current, venous hum*). Somewhat similar to the sound of the bellows of a forge, it becomes at times snoring and sonorous, so far as to imitate the sound produced by whipping a humming-top. Finally, at other times there is heard, either alone, or combined with one of the two preceding varieties, a sibilant and musical noise formed of a succession of sounds, diversely modulated, and which has been compared to

the resonance of the diapason, to the vibration of a metallic cord (*musical sound, song of the arteries*).

These three species of sounds are very variable in their intensity and in their character; they modify themselves, increase or diminish, by the least change in the tension of the parts or under the pressure of the stethoscope. They show themselves principally in the vessels of the neck, oftener on the right than on the left, and much oftener in women than in men.

These vascular sounds are almost exclusively connected with diseases of the blood; they are the most certain indication of advanced chlorosis and of anemia with notable diminution of the sanguine globules.

Chapter III.

Auscultation of the Abdomen.

In the normal state, in auscultating on the abdomen, we hear scarcely anything but the sounds of the gases which displace each

other in the digestive tube, and the aortic beating already pointed out: the greater part of the acts which are performed in the abdomen are not manifested by any appreciable sound. In the pathological state, the movements of the parts covered by the peritoneum, which normally take place in silence, may produce, when the inflamed peritoneum is hung with pseudo-membranes, a sound of friction, which is much rarer and weaker than the pleuritic friction, and which is scarcely produced except on the line of organs of some resistance, the liver for example.

Shocks given to the trunk sometimes produce in the stomach a very distinct sound of fluctuation in cases of contraction of the pylorus. In stricture of the intestine, there is also often heard a surging noise (*bruit de flot*) due to the displacement of the liquids and gases by the strong contractions of the hypertrophied intestine. A rumbling perceived in hernia would announce the existence of enterocele. A shivering developed by percussion in a tumor of the right hypochondriac would point out the presence of a hydatid cyst. A sound of crepitation produced by pressure upon the region of the gall-bladder would cause us to suspect an accumulation

of biliary calculi. Pressure upon the loins would perhaps manifest a sound of analogous friction in cases of multiple renal concretions. In certain voluminous tumors of the kidney the production of a metallic tinkling, would announce that the cavities of this viscus, considerably distended, contained at once liquids and gases. The presence of one or more calculi in the bladder would easily be recognized by a peculiar rattling produced by the blow of the catheter, and transmitted to the ear by the stethoscope applied to the pubis, or by the probe itself furnished with an acoustic tube. Finally, if we had just distinguished double pulsations in a voluminous tumor of the lower belly, we should have to conclude that there was extra-uterine pregnancy.

Chapter IV.

Auscultation of the Head.

In auscultating on the head of a person in good health, we perceive the respiratory sound and the vocal laryngeal resonance

which sound together in the nasal fossæ; there are also heard the sounds of deglutition, of suction, and the transmitted tick-tack of the heart.

The auscultation of the cranium in young children, in whom the fontanels are not closed, reveals, at times, in the pathologic state, a sound of souffle, systolic, soft, almost always intermittent, very rarely continuous, with or without strengthening (*renforcement*). The cephalic souffle, far from being met with, as Messrs. Fisher, of Boston, and Whitney pretend, in all cerebral diseases, is found in one alone, in chronic hydrocephalus, and then in a small number of cases. But it is frequently met with, like the sounds of the vessels of the neck, in alterations of the blood; so that if its semeiotic value is null in diseases of the encephalon, it should, at least, be considered as a symptom of anemia, either simple or connected with some other affection, principally rickets. According to Mr. Gendrin, the changes of the arteries, even in the interior of the cranium, may be made known by anomalous sounds. Finally, according to Dr. Ménière, the introduction of air into the cavity of the tympanum produces a sound of souffle when this cavity is empty,

a whistling when it is very dry, and a blebby rattle when there are liquids which the air traverses in passing therein.

Chapter V.

Auscultation of the Members.

Besides the sounds furnished by the alterations in the arteries already spoken of, there is heard upon certain erectile tumors, a manifest sound of souffle. The same is the case in exophthalmic goitre.

The sounds that are caused by the striking of a probe against a foreign body at the bottom of a wound, may reveal the nature of this body. In certain patients, affected with arthritis, the slipping of the opposite articular surfaces produces a sound of friction analogous to that of the pleura. In doubtful cases the application of the stethoscope on the place of a fracture would allow us to seize, at the least motion, a crepitation which might have escaped the ear alone, even on much more considerable motion.

Chapter VI.

Obstetrical Auscultation.

In pregnancy, after the first half of gestation, several sounds are heard,—of which one is connected with the circulation of the mother (*uterine souffle*), and the others depend on the fœtus; the latter are produced either by the beating of the heart of the embryo (*sounds of the fœtal heart*), or by its motions in the womb (*sounds of displacement of the fœtus*). At times again there is perceived a souffle synchronical with the fœtal pulse, and which appears to take place in the cord when this vascular body is wound around the neck of the fœtus, or when only compressed between the back of the child and the uterine walls (*umbilical souffle*); this latter sound is much rarer and much less important than the preceding ones.

A. The uterine souffle is a soft souffle, synchronical with the pulse of the mother, more or less prolonged, of a tone sometimes sonorous, sometimes more acute, and sometimes even a little musical. Heard most commonly about

the inguinal regions, it is in the meantime movable and may disappear momentaneously and be reproduced again without any fixed rule. It usually shows itself about the fourth month, and beyond the fifth it is rarely wanting.

As the uterine souffle is a nearly constant phenomenon in pregnancy and very rare in other conditions, it is a very probable, but not a certain symptom of gestation; and as also it is wanting in some cases, its absence is not sufficient to exclude the idea of pregnancy.

B. *Sounds of Displacement of the Fœtus.*—Sometimes it is a shock, single or redoubled, sometimes a sound of slow and prolonged friction, giving the evident sensation of a body which is displaced. These phenomena generally begin to be perceptible about the fourth month, and when they are very manifest they announce with certainty the existence of a living fœtus.

C. *Sounds of the Fœtal Heart.*—These are double beats, similar to those that are perceived in auscultating the heart of a newly-born child. Habitually about the fifth month we begin to hear them; at first weak, they gradually increase in force and are usually repeated from 130 to 140 times in a minute.

Their frequency and their intensity experience also momentaneous variations independent of the maternal circulation.

Their seat corresponds, in different women, to various points of the abdomen; besides, it often changes in the same woman. But usually towards the close of pregnancy the double sound becomes more fixed, and it is found commonly towards the left iliac fossa. Besides these momentaneous variations of intensity and of character, it may, in cases of disease of the fœtus, be changed into souffle, and it ceases definitely on the death of the child. As this sign is scarcely ever wanting after the fifth month, it has great value. However, the absence of double pulsations does not prove that there is not pregnancy; it has little importance in the four first months; but starting from the fifth, every day it fortifies more strongly the presumption of the non-existence of the fœtus, without, however, positively establishing it until the term. The presence of double pulsations, on the contrary, is the surest sign of pregnancy.

To find them very plainly in two points at a distance from each other, would render probable the existence of double pregnancy, and this would be certain if the number of beats

was always different on the right and on the left.

The distinctness, force, and regularity of the sounds announce that the fœtus is in health; their alteration, their weakness, and their intermittence, would reveal that it is in a state of suffering or of disease; finally, the increase of these derangements, and the complete cessation of the double sounds, would indicate that the child had ceased to live.

Chapter VII.

Dynamism.

When with the aid of the dynamoscope we auscultate the different parts of the body, we hear a dull hum, intermingled with cracklings, and somewhat analogous to the distant rolling of a heavy carriage. This sound, in the physiological state, presents, according to age, and several other conditions of life, different shades of strength, tone, and character; it is generally soft, uniform, and permanent, perceptible on all the regions of the trunk and of the members, but always more

clearly manifested at the ends of the fingers than anywhere else. In the pathological state, the murmur (*bourdonnement*), becomes stronger and more harsh at the beginning of febrile affections. It is weaker on the contrary, in the side struck with hemiplegia in a case of cerebral hemorrhage. It is null in members entirely paralyzed. It often diminishes also in the course of acute and chronic diseases; the degree of its weakness is frequently in direct ratio to the gravity of the disease, and its complete abolition is the indication of approaching danger. It almost always ceases to be perceived in the fingers five or six hours before the death agony.

The murmur is accelerated in the febrile state; it is unequal, jerky, trembling in the paroxysms of pyrexiæ, and in the attack of periodic fever; in some cases it becomes intermittent, and this change of rhythm is an unfavorable symptom, as much more serious as the intervals of silence are more prolonged.

Finally, the murmur may present variations of tone and of sound that are frequently met with in acute diseases of a grave nature, and this dissonant and movable sound is generally the indication of great danger.

But it is from the point of view of the distinction between real and apparent death, that the exact idea of the murmur (*bourdonnement*), has its chief importance. In fact, as this sound does not disappear entirely until twelve or fifteen hours after decease, its persistence is an indication that organic life is not absolutely extinct; its complete and definitive cessation is, on the contrary, one more sign of the certainty of death, and thus dynamism constitutes a means of preventing premature burial.

PERCUSSION.

The origin of percussion goes back to the earliest antiquity. It is extremely probable that Hippocrates made use of it in order to recognize tympanites.* Arétée mentions it positively when he says: *Nam, si præ inflatione, quum verberantur, tympanum quodam modo referant, τυμπανίας nominatur.*† Galen also employed it to distinguish tympanites from ascites, and from œdema of the abdominal walls.‡ Actuarius also mentions percussion in connection with the same disease.§ Paul,

* *Aphorisms*, sect. iv, aph. 2, coac. 491, 496.

† *De signis et caus. diut. morb.*, lib. ii, cap. i, *De hydrope;* ed. Henr. Stephani, 1567, t. i, p. 36. A little further on he says again: "Tympanias autem . . . auditu sonorus est, nam ad palmæ percussum abdomen sonum edit."—Ibid., p. 37.

‡ "Sed ad veram notitiam comparandam pulsare cogimur abdomen, ut attendamus si veluti tympanum resonet."—*De dignoscendis pulsibus*, liber iv, caput iii, Ed. Kuhn, vol. viii, p. 951.

§ ". . . . Qui quum aegri abdomen pulsatur, tympani in morem intumescat, τυμπανιας dicitur. . . . . "—*De methodo med.*, lib. i, cap. xxi, Ed. Steph., t. ii, p. 164 G.

of Egina, goes farther, and notes the resonance of the superior part of the abdomen in peritoneal pneumatosis,* and that of the inferior part in uterine tympanites.† At an epoch nearer to our own, the employment of percussion often appears in gaseous effusions. Tugault applies it to ascites ;‡ Lazare Rivière makes use of it for diagnosis of uterine hydropsy,§ and of hypertrophy of the spleen.‖ Other authors have also made mention of it. However, these are only scattered facts, incomplete notions, none of which besides relate to the chest. Nowhere are these elements reunited; nowhere are they co-arranged

* "In quâ (affectione) aliquando flatûs copia cum paucissimâ humiditate coacervatur, inter membranam peritonæum apellatam, ac intestina, adeò ut si verberetur superior venter instar tympani sonum edat."—*De re med.*, lib. iii, cap. xlviii, Ed. Steph., t. i, p. 471 D.

† "In his sequitur tumor imi ventris, . . . et ad digitorum illisionem sonitus tympani oboritur." *De re med.*, lib. iii, cap. lxx, *De inflatione uteri ;* Ed. H. Steph., t. i, p. 487, B.

‡ "La tumeur aqueuse ne sonne comme vent, mais comme eau."—*Chir. de J. Tugault*, Lyon, 1580, p. 143, d'aprés M. Pigné.

§ "Si à flatibus (uteri hydrops) excitetur, imus venter percussus sonitum edit . . . Si verò ab humore seroso fiat, gravitas major adest in parte, et sonus veluti fluctuantis aquæ."—Riverii *Opera med. omnia*, cap. xii, p. 391, Genève, 1737.

‖ " . . . . . A tumore flatuoso distinguitur qui murmur acsonum edit, qui in scirrho (lienis) non reperiuntur."—Ibid., cap. iv, p. 333.

and combined so as to constitute a method. Auenbrugger is the first who occupied himself with percussion in an especial manner; and he may, by just claim, be considered as its inventor. However, in spite of the treatise which he published in 1761,* his discovery passed almost unobserved, and percussion was not slow in falling back into oblivion.

To Corvisart belongs the merit of having caused it to revive in France, and of having spread the use of it abroad. However, as it was practised at that time, immediate percussion was not without inconvenience; its application was restricted and its data had not the desirable exactness.

To Mr. Piorry the science owes that perfecting of which it was in need. Thanks to a happy modification, percussion made mediate has been more frequently applicable, and its results have become much more exact. At the same time, Mr. Piorry fixed its value by numerous experiments upon the dead

* *Inventum novum ex percussione thoracis humani*, &c. Vienna, 1761. Translated into French by J. N. Corvisart, under the title of "Nouvelle méthode pour connaitre les maladies de la poitrine par la percussion de cette cavité." Paris, 1808. (New method of recognizing diseases of the chest, by the percussion of that cavity.)

body, he traced its rules with extreme care, and gave it greater extension by applying it to a great number of cases, in which it was not yet employed. From that time, percussion has become more popular every day, and this method now constitutes, with auscultation, the most solid basis of diagnosis.

GENERAL RULES.

In order that percussion may furnish sure and useful results, the observation of several general rules is necessary. The physician should, above all, choose a convenient position: in general he may place himself indiscriminately on the left or on the right of the patient; the important point is for him to be at ease, in order that he may conveniently percuss, at a right angle, and with an equal force, the different regions that he explores; he must also strike neither from too near, nor from too far; too great a difference in the distance from which he strikes not being without effect on the difference of the sounds produced. Further, if the results of the exploration appear doubtful, the physician can pass alternately from the left to the right, repeating the examination every time in inverse

positions. It often happens that by means of this counter-proof, we confirm a doubtful estimation, or reform an erroneous first judgment.

Percussion may be immediate, that is to say, practised directly upon the parts of which we desire to ascertain the degree of sonorousness. In this case we percuss with the ends of the four fingers united in a line, and stretched out, or rather lightly bent, so as to form an angle more or less right with the metacarpus, but always kept near each other; we can also percuss with the flat of the hand, or at times even with the end of the stethoscope, if we only desire rapidly to take an idea of the general sonorousness of the thorax, before proceeding to a more regular and more complete exploration.

This mode of operation is frequently inconvenient: generally the sound that is drawn from parts thus struck is obscure, or badly delineated; in order to obtain it more distinct and pure, we must employ a certain force, and then percussion becomes painful to the patient, above all if we operate on inflamed parts; it is not at all practicable on the mammæ; it is difficult in fat persons, whose thoracic walls have great thickness, in dropsical

persons, whose subcutaneous cellular tissue is infiltrated with serosity; it is still less practicable upon the abdomen, which does not offer the elastic resistance of the thorax. It is not even without danger; blows direct and little guarded may produce a grievous concussion in the parts struck, and if they are too violent, may produce, for example, the rupture of a cyst, or of an aneurismal tumor.

This is not all: a few smart shocks given to the walls of the chest will allow us to have a summary idea of the general sonorousness of the thorax; this manner of proceeding, perhaps suffices to prove a very manifest change of sound, and to make known a very extensive lesion, but it will allow lighter modifications to pass unperceived, and will cause us not to appreciate very limited lesions. But if it is necessary sometimes to content ourselves with this immediate and rapid percussion, in cases where the weakness of the patient opposes itself to a long examination, every time that it is possible to choose, we must prefer *mediate percussion.*

The latter consists in interposing a body of a variable nature between the hand that strikes, and the part struck. This process

has an incontestable superiority over the preceding.

The sounds that are produced are clearer and more distinct; there is need of much less force to obtain them, and the intermediate body weakens the shock of the hand that strikes; mediate percussion is consequently much less painful, it can be prolonged with more facility, and practised without danger on delicate or sensitive parts, and it becomes applicable in cases where direct percussion could not be employed; it permits us to recognize lesions that are not strongly marked, and are of small extent; it furnishes the means of bounding diseased organs, and of estimating their forms; consequently, of following them, so to speak, in the physical changes which their volume may undergo; finally, it may also give us an idea of the different degrees of their density, by the greater or less resistance, that the finger feels.

In mediate percussion, the body interposed may be, either the pleximeter of Mr. Piorry, or a plate of caoutchouc, or the finger of the observer. The pleximeter (πλήσσω, I strike, μετρον, a measure), is a plate of thin ivory, circular or oval, plane upon its two faces, furnished at the two opposite points of its

great diameter, with vertical laminæ or ears, intended to fix it in place.* Very convenient for the percussion of the abdomen, and upon corpulent chests which present a uniform plane, the pleximeter offers fewer advantages when we investigate a patient whose thorax is much attenuated; it is not easy to apply it exactly in intercostal, depressed spaces, without causing some pain, and the peculiar resonance of the stricken ivory mixing with the sounds given out by the interior organs, might affect the purity of them.† To avoid these inconveniences, it

* For the very numerous modifications that the pleximeter has been made to undergo, for its graduation, for the different hammers destined to replace the finger which percusses, &c., consult the special works of Mr. Piorry, on mediate percussion, &c., 1818 (*De la percussion mediate*); Of the operation to be followed in the exploration of organs by percussion, &c., 1831 (*Du procede operatoire a suivre dans l'exploration des organes par la percussion*); and the treatise of Mr. Maillot, Practical Treatise on Percussion, &c., 1843 (*Traite pratique de percussion*).

† These are the rules drawn out by Mr. Piorry, for the use of the pleximeter: The instrument will be kept solidly fixed between the thumb and the indicator of the left hand, and very exactly applied to the parts, *so that it shall in some degree make one body with them.* When we desire to obtain a great deal of sound from an organ, the fingers which percuss ought to be held in the following manner: the index and the medius ought to be exactly adapted to each other, by bending the medius a little more, on account of its greater length, so that its extremity shall not pass beyond that of the indicator. The thumb is

has been proposed to reduce the size of the plexímeter, or to substitute for it a little plate of caoutchouc, whose application can be made more accurately, and without pain, but with which it is difficult to produce much sound. *Digital* percussion therefore seems to us preferable; the finger, composed of hard and soft parts, approaches in its structure that of the thoracic walls, and produces less change in the sounds which these send forth. Pressure in cases where it becomes necessary, is less painful; thin and narrow, it is easily put between intercostal spaces, or upon depressed spots; flexible, it moulds itself to prominent or even to rounded parts; organ of touch, it adds tactile sensation to the perceptions of hearing. Finally, and it is a consideration not to be despised, the finger is always at the disposal of the physician, whom the loss of his plexímeter might embarrass.

It is upon the index, and much better still upon the medius, that percussion is generally

then propped with force against the joint of the second and third phalanges of the indicator. These three fingers thus reunited, constitute then a very solid whole, whose percussing surface, if the medius is a little bent, has only the extent of the pulp of the index alone. It presents the dimension of the end of these two fingers united, if they are kept on the same line.—*On the operation, &c.* (*Du procede operatoire, &c.*), p. 44.

made; it is almost always placed in pronation, but rarely it is more convenient, on account of the attitude of the patient, to strike upon the palmary face of the finger, reversed in supination. We generally proceed in the following manner:

The whole of the left hand* is applied to the region whose sonorousness we wish to investigate, and it is thus kept fixed; then the medius is isolated from the other fingers; well stretched, it adapts itself exactly to the subjacent parts, by means of a light pressure, if the latter are painful, or if we have to do with an organ superficially situated, and stronger if there is no pain, or if we are exploring deeply-seated organs. The motions of the right hand which strikes, ought not to be from the shoulder, nor even from the elbow, but exclusively from the wrist; they are thus more measured, and more precise, and the shocks much less painful to the patient, at the same time that the sounds produced have more clearness.

* It is rare for any one to be sufficiently ambidextrous to execute the same movements in an inverse manner; it would be better, as we have said, to pass on the other side of the patient, if percussion present any difficulty in that position.

If it is necessary to strike with a certain amount of force, on account of the thickness of the thoracic or abdominal walls, or of the depth at which the viscera are placed, and if the absence of pain permits these blows to be somewhat energetic, we percuss with the three fingers brought near to each other, and bent at a right angle. Two fingers are sufficient if less force is needed: but if the parts struck are the seat of acute pain, or if the organs that they cover are superficial, even light percussion with the medius alone will give a sufficient result.

In general, we should accustom ourselves to striking gently; this manner of operating adds to the advantage of being less painful, that of preserving the internal sounds in all their integrity. In all cases, the percussion ought to be moderate at first, to accustom the patient to it; the practitioner will afterwards use increasing force, and stop at that manner which gives the best results. Superficial or profound percussion is also demanded by different situations, whether of the organs in relation to each other, or of lesions in one or another stratum of these organs.*

* Mr. Maillot thus expresses himself on this subject, in accordance with the precepts of Mr. Piorry: "A light percussion

The hand which percusses is brought down and raised by turns, and strikes perpendicularly several successive blows separated by very short intervals; sometimes we are satisfied with a short and dry shock, after which the finger rises immediately; at other times, on the contrary, we leave it some seconds in contact, with the aim of arresting the sonorous vibrations, and consequently of judging better of the degree of resistance and hardness of the subjacent organs.

Habitually, we begin by percussing in the centre itself of the region corresponding to the diseased organ. But it is often more advantageous to explore at first the surrounding parts, and thus to arrive progressively at the ailing viscera. In this way, the contrast between the healthy parts and those which are the seat of lesions is more evident, and the ear seizes better the lightest shade of sound, which expresses immediately a physical change, even when but little marked.

Sometimes it is important to designate by lines, with nitrate of silver, or better still

will permit us to estimate the superficial strata of the lung; and rendered stronger by successive degrees, it will enable us to judge of the density of the lungs at different depths." (Loc. cit., p. 75.)

with a soft pencil, the points where the lesion begins, and to define the ailing organs; this exact circumscription, constantly practised by Mr. Piorry, and which he has generalized under the name of organography* (*organographisme*), allows us to follow, as if step by step, the increasing or decreasing progress of the disease, and it may consequently be the source of valuable indications for prognosis and therapeutics.

Besides the general rules that we have just drawn out for the physician who percusses, there are still, as relates to the patient, certain rules that it will be well to observe. The region examined ought to be naked or covered with thin clothing; stuffs of silk and wool will be proscribed on account of the sounds produced by their friction.

As to the position of the patient,—generally symmetrical, it will vary according to the regions that are sounded. Sometimes it will be necessary to modify it during the same examination, and, for example, if the question is to discover the presence of an effusion in the pleura, and especially in the peritoneum,

* See l'Atlas de Plessimétrisme, Paris, 1851 (The Atlas of Pleximetry).

we give the trunk different inclinations in order to carry and unite the liquid in the parts declined.*

DIVISION.

Percussion is applied especially to the chest and abdomen, and exceptionally to the head, neck, and members.

Sec. I. Percussion of the Chest.

The percussion of the chest comprises the examination of the pulmonary apparatus, and that of the circulatory apparatus.

Chapter I.—PULMONARY APPARATUS.

§ 1. Especial Rules.

For percussion of the anterior part of the thorax, the patient may stand; but as the body wants support in this position, it is better for him to be seated, with the back

* It is superfluous to add that in percussion as well as in auscultation, silence around the observer is necessary during the whole time of the examination.

propped. In either case, the arms will be pendant at the sides of the body, the head held straight, the shoulders slightly kept in. Lying upon the back, more or less horizontally according to the degree of dyspnœa, is preferable. The thorax thus reposes on a resistant plane; the arms are placed beside the trunk; and throwing the shoulders a little backwards in order to stretch the muscles moderately, the effort is to give to the trunk a perfectly symmetrical position. For examining the subclavicular region, on the right or left, the head will be carried alternately to the side opposite to that which is explored.

In order that percussion of the lateral portions may be possible, the patient, standing or seated on a chair, or lying on the side opposite to that which is to be examined, will raise his arms, stayed upon his head, or supported by an assistant.

In endeavoring to explore the posterior parts of the chest, the standing posture will not be so good as sitting in the bed or on a chair; in all cases the head should be bent, the back arched, and the arms will be crossed or carried in front in such a way that the scapula, removed from the vertebral column, may be fixed to the thorax with ex-

actness and the muscles may be moderately stretched; too great tension would have the effect of diminishing the sonorousness of the chest. In exceptional circumstances, the patient is put on all fours upon his bed, so that we may assure ourselves whether the dulness is movable and whether it is owing to a liquid susceptible of displacement.

One especial rule, the observation of which is very important, is to sound the two sides of the chest in comparison with each other, under conditions entirely identical; and, for this purpose, percussion should be practised, by turns on the right and on the left, on points exactly correspondent, in the same position, with equal force, during inspiration and expiration.

§ 2. Physiological Phenomena.

Percussion practised upon the thorax in its different regions, produces very valuable sounds; the knowledge of these varieties of the normal state is of great consequence in appreciating the different modifications appearing in the pathological condition.

It is difficult to characterize by words the natural resonance of the healthy thorax: it

is a clear sound, *sui generis* (pulmonal of Mr. Piorry), which should be well studied in advance, by percussion upon the dead body, or by preference on healthy individuals, so as to habituate the practitioner to recognize easily all its shades. It is understood that this sound varies according to the different degrees of thickness of the thoracic walls. In front, it is clear above the clavicle (at a height of 25 or 30 millimeters),* and upon this bone itself; clear and more pure yet in the subclavicular region (from the clavicle to the fourth rib exclusively), it loses a little of this clearness, especially in fat persons, on the line of the mammæ. On the left it is obscured in the præcordial region,† and farther down the pulmonal sound is formed again, until about the seventh rib, a point where it gives place to the tympanic resonance produced by the great extremity of the stomach. On the right it is clear from the top of the thorax down to a level with the sixth or seventh rib; setting out from this limit, it begins to be replaced by the more and more complete dulness of the liver.

* The millimeter is less than 0.04 of an English inch.—TRAN.

† See *Percussion of the Heart*, p. 112.

The median portion of the anterior wall of the thorax, in other terms the sternal region, offers in its upper part a clear sound, less pure, however, than that of the subclavicular region, and which, about on a line with the third rib, is obscured as far as the xiphoid appendage.

Laterally, in a region bounded on each side by the vertical line let down from the anterior and posterior edges of the arm-pit, the pulmonal sonorousness is very great; from the axillary hollow to the fifth, sixth or seventh rib downwards.

Behind, the sonorousness exists from top to bottom, in the interscapular region; but it is mediocre and it ceases at the level of the second or third false rib. More outwards, in a region limited externally by a vertical line dropped from the posterior edge of the arm-pit, we find the supraspinatus portion where the pulmonal sound is very obscure on account of the thickness of the thoracic wall, and the infraspinatus portion where the obscurity is a little less. Fortunately in these points we may, by deep percussion, obtain the sensation of a normal elasticity, easy to be distinguished from the resistance to the finger that the true pathologic dulness presents. Lower down,

in a region corresponding to the angle of the ribs, the pulmonal sound reappears in all its clearness. Some centimeters* further down it is replaced by a dulness, produced on the right by the posterior edge of the liver, and on the left by the spleen. This inferior limit is generally not so low on the right, because of the pressing back of the diaphragm by the liver; sometimes, on the left side, the pulmonal sound gives place to the tympanic resonance of the distended stomach.

Independent of these varieties which the pulmonal sound presents according to the different points where it is sounded, there are still differences which depend on the age of individuals, and on the physical condition of the chest. Thus the resonance is a little greater in old men with lean chests; it is much more marked, and as it were tympanic, relatively, in very young subjects, and in them this excessive resonance is very well explained by the want of thickness of the muscular strata. In general also, the sonorousness is much more intense, when the chest is large and its walls thin; it is much less when the

* Centimeter, rather more than 39-100ths of an English inch. —TRANS.

thorax is narrow, and its walls thickened by the development of the muscular system or by the bed of fat. We must not forget that in rickety malformations, the resonance is usually less, in consequence especially of the mechanical and slow compression that the substance of the lung has undergone, and of the thickening of the bones of the thoracic cage. We have often verified these physical changes of the pulmonary parenchyma and of the bony tissue in children who sink at an epoch when rachitis is at its ascending period.

§ 3. Pathological Phenomena.

In the state of disease the sound returned by the thorax at the points which correspond to the lungs, may present numerous varieties of force and of character. It becomes at times clearer and more intense; at times more obtuse and dull; at times again it is distinguished by a peculiar tone.*

* M. Skoda took especial note of the tone of the sounds produced by percussion. M. Woillez, who has likewise especially treated the tone (*tonalité*) of these sounds, proposes the following division: Any sound of percussion whatever, says he in an important memoir (*Etudes sur les Bruits de Percussion Thoracique.* Arch. Génér. de Méd., Mars et Avril, 1855. Studies on the Sounds of Thoracic Percussion, &c.), ought to be studied as a compound which has three fundamental elements which must be ex-

A. The increase of sonorousness is shown under two principal forms: in the first degree, the exaggerated sound that is obtained by percussion preserves the character of the natural resonance of the chest (*clear sound*); at a more elevated degree, it takes on a resonance analogous to that given by the left hypochondrium when the stomach is distended by gases (*tympanic sound*).

a. The clear sound is itself more or less marked; it may be general or partial, extend to the whole surface of the thorax, or remain limited to a circumscribed region of one or both sides of the chest.

As sonorousness varies much in the normal state, it is not always easy to tell whether in a certain individual, it is really in excess, especially when the chest is everywhere very sonorous: in this case we must consider the conformation of the thorax, and pay regard to its size as compared with the degree of plumpness of the soft parts. When the excess of sound

amined separately. Every resonance of this kind presents, 1st, a normal tone, either more grave or more acute ; 2d, a normal intensity either diminished or increased ; 3d, and finally, as a complementary element, there is thoracic elasticity under the finger that percusses, and which is also either normal, or augmented, or diminished (and sometimes also perverted, for instance, by the hydatic shuddering,—*frémissement hydatique*).

is partial, it is easier to prove; however, when it exists on both sides at corresponding points, we might still doubt its reality, and we must recall the relative shades that have been pointed out for the different regions.

Finally, when it takes place only in one-half of the chest, we might sometimes suppose this side, pathologically more sonorous, to be the one whose resonance was normal, and believe on the contrary, that the natural sound of the healthy side was diminished by a morbid condition. We must then examine whether there is at the same time, hollowness, and which of the two sides is more nearly normal in shape, or dilates more regularly; also at times, we must auscultate comparatively so as to decide the question.

A simple excess of sonorousness may, as we have seen above, exist independent of any lesion of the organs contained in the thoracic cavity, and be only the effect of leanness. Often also it is a symptom of lesions of the walls or of the subjacent viscera: it may be met with in the case of hernia of the lung and of subcutaneous emphysema; but much more frequently it is connected with different forms of pulmonary emphysema. Rarely, on the contrary, is it

owing to the existence of a cavity or of dilatation of the bronchi.

Again it is undeniably established (as Dr. Skoda has pointed out)* in pleurisy with effusion and hydrothorax, below the level of the liquid.†

Finally, in certain cases of pneumonia of the posterior and superior part of the lung, an exaggerated sound is heard in front, in the subclavicular region.

When the exaggeration of sound is only the result of leanness, it shows itself everywhere with the degrees of relative intensity that we have assigned to the different regions of the chest in the normal state; the intercostal spaces are depressed, the clavicles are prominent, but the chest preserves its regular conformation.

Emphysema of the thoracic walls is discovered still better than by pleximetry, by

* Auenbrugger had already noted this fact, as may be seen in the following passage: "Si media pars aquâ repleta fuerit, evocabitur resonantia major in illâ parte quam aquosus humor non occupaverit." Hydropis pectoris signa.

† 41 times in 51, according to the observations of one of ourselves (*Recherches Cliniques, &c.*). Clinic Researches upon some New Symptoms furnished by Percussion and on the Tympanic Sound in Liquid Effusions of the Pleura; by H. Roger. Archives Génér. de Med., July, 1852.

tumefaction of the soft parts, and especially by the peculiar crepitating sound which they give out under the pressure of the fingers.

Hernias of the lung, without division of the integuments of the chest, are rare facts; however, they may be met with; and if a soft elastic tumor, appearing on some part of the thorax, gives a very clear sound on percussion, we could not be mistaken in considering it a pulmonary hernia.

In case of emphysema of the lung, the excess of sound may be general, extending over the whole chest; but it is rarely that there is not predominance of sonorousness, in one point or another of the thorax, rare for it not to be more decided, for example, on the line of the costal cartilages, or for it not to be more marked in one part, or in the whole, of one side compared to the other. Besides, most frequently, the chest is modified in its form; it is more bulging than in the natural state; the intercostal spaces are more or less raised, and the clavicles very slightly prominent. In cases of partial emphysema, the excess of sonorousness habitually coincides with an appreciable hollowness, especially at the anterior part of the thorax. Let us add that when emphysema is somewhat considerable,

the præcordial region is itself often very sonorous, because the heart is found covered by the anterior edge of the left lung; and the inferior limit of this exaggerated sound descends lower than is normal, on account of the depression of the diaphragm.*

On a level with pulmonary excavations, it is only by exception that the sonorousness of the chest is augmented. For this to be the case, the cavities must be spacious, filled with air alone, and the surrounding tissue must have remained flexible. Now it is quite rare to find these conditions united; besides in this case itself, there is not simply exaggeration of the ordinary pulmonal sound, but the character of the sound obtained is different, it is remarkable for its clearness rather than for its intensity, and often it approaches the resonance that is produced by the percussion of an empty vase.

Another distinguishing mark of this clear sound belonging to cavities, is that it is cir-

* Let us remark, with Mr. Skoda, that in general emphysema of the lung, excessive and accompanied above all by a strong tension of the thoracic walls, the sound may not only not be exaggerated, but also appear less intense than in the normal state. The case will be the same in pneumothorax with excessive distension of the pleura and the walls of the chest. (See the experiments recorded in the memoir just cited.)

cumscribed to an inconsiderable extent, and that it is usually met with below the clavicle.

Excess of sonorousness is also a fact rarely observed in dilatation of the bronchi, this lesion being usually accompanied by augmentation in the density of the pulmonary parenchyma.

The exaggerated sound that is met with at times in pleural effusion, is distinguished by this, that it has its seat under the clavicle, above the level of the liquid, and that further down it gives place to a dulness progressively more marked. Finally, when the excess of sonorousness is caused by subjacent pneumonia, auscultation intervenes uselessly to determine its morbid signification.

b. The *tympanic sound** of the chest is entirely analogous to that which is given on percussion by the left hypochondrium, when the stomach is distended by gases. This

* In order not to complicate, in a *compendium*, the study of percussion, we have preserved for the word "*tympanisme*" the restricted sense that Laennec attached to it; Messrs. Skoda, Woillez, etc., took it in a much more extended acceptation, and consequently met with the tympanic sound in a great number of diseases. (See the Treatise on Percussion of the German doctor, and the memoir of M. Woillez on *tympanisme* in the Chest. *Du Tympanisme dans la poitrine.* Arch. Gén. de Méd., Sept. 1856.)

resonance usually takes place only on one side of the thorax; rarely also it extends to a whole half of the chest, and habitually it occupies only a more or less considerable space. Frequently it appears in an abrupt manner, at the same time with a dilatation of the pectoral walls on the corresponding side; rarely it persists in the extent at which it was first verified, and in general it is quickly circumscribed.

This remarkable sonorousness indicates a gaseous effusion in the pleura. Its intensity is generally in proportion to the quantity of gas poured out, and gives the measure of the compression that the lung has suffered;* the extent in which it is perceived is in relation to the space occupied by the elastic fluid.

It is rare for the tympanic sound to extend to a whole side, because usually pneumothorax supervenes in consumptive patients in whom the lung has contracted adhesions to the top of the chest. At the beginning of this pathological state, the phenomenon is at times perceptible even to the base of the thorax; and as this morbid resonance has much analogy with the normal tympanic

* See the end of the note, p. 100.

sound of the stomach, we might sometimes commit an error, and believe in pneumothorax, when in a tuberculous patient the stomach, distended by gases, pushes back the diaphragm towards the superior part of the chest; but auscultation will dissipate all doubts. Besides, the introduction of air into the pleura is not slow in giving cause to inflammation of this membrane, and to a liquid effusion which is made known by a greater or less dulness in the inferior regions.

It is auscultation again which comes to the succor of the physician, in these sometimes rather difficult cases of differential diagnosis, when the gaseous effusion having formed in the pleural cavity slowly and in small quantity, without simultaneous development of grave functional symptoms, pneumothorax would give cause to a tympanic resonance but little marked, which might induce the belief that this was a case only of the exaggerated sonorousness of pulmonary emphysema.

B. Diminution in the sonorousness of the chest may also present different shades; we habitually distinguish two varieties, namely: the *obscure sound* and the *dull sound.*

a. The sound is called *obscure*, when there

is still a certain amount of resonance, and in this case, the resistance to the finger is generally but little marked. This obscuring of the sound may also be met with independent of any morbid condition, and may be the effect of considerable development of the muscles, or of thickness of the bed of fat. We perceive that this phenomenon is not pathological, by this peculiarity, namely, that it exists on both sides; equal at correspondent points, and that it presents, in different regions, the degrees of relative density that we have pointed out.

The obscuring of the sound is frequently observed in morbid conditions, either of the thoracic walls, the pleura, or the lungs.

The single fact of a strong tension of the walls of the chest, whatever be the cause thereof, is sufficient to produce a more or less obscure sound. It is the same in œdematous infiltration of the walls of the thorax, but this lesion is better revealed by the ready depression of the skin. An abscess developed in the walls might also produce an obscure sound, limited by a circumscribed tumefaction. In some patients attacked by intense pleurodynia, it has appeared to us that the pulmonal sound was diminished, and this

diminution has seemed to us to take possession especially of the incomplete *ampliation* of the diseased side.

Much oftener obscurity of sound belongs to lesions more deeply seated. It often exists in pleurisy, and is met with either at the beginning of this inflammation, when there has formed in the pleura an effusion of liquid as yet inconsiderable, and especially when the partial adhesions of the two pleuræ allow the liquid to mount between them under the form of a light layer, or later when the pleural leaves are hung with thick false membranes infiltrated by serosity; or later yet, when the lung, long compressed, and enveloped by pseudo-membranes, can no longer return to its primitive volume, and the walls of the chest yield. At times also, the diminution of sonorousness depends on light hydrothorax. In all these cases, it has usually its seat at the base of the chest. In simple hydrothorax it is displaced when the patient is obliged to change his position; this displacement is, on the contrary, difficult or impossible in the other affections of the pleura that we have just mentioned.

Obscurity of sound is found again whenever the pulmonary parenchyma has lost its

lightness and has become more dense; in congestion, at the beginning of pneumonia, in hypostatic choking (*engouement*), in phthisis, and in serous or sanguine infiltration of the pulmonary tissue (apoplexy or œdema); or yet again consecutively in dilatation of the bronchi, or at the development of different morbid productions, such as cancer and melanosis.

In all these cases, the dulness is fixed, and it presents no especial characteristic which can serve in differential diagnosis. Nevertheless, in pulmonary hypostatic congestion, it is only behind and below that the sound is diminished; somewhat habitually the same is the case in pneumonia.

In phthisis, on the contrary, it is especially at the top that we verify the obscurity of the sound, either behind or under the clavicles. In other affections, there is nothing especial in the seat of the obscure sound, and we must necessarily recur to other methods in order to establish the diagnosis.

b. The sound is called dull when it resembles that heard in percussing the thigh (*tanquam percussi femoris*). It may have a variable seat and extent, may occupy sometimes a whole side of the chest, or be limited, on the contrary, to a circumscribed point. It is

generally accompanied by a resistance to the finger, more or less noteworthy.

Dulness depends either on a considerable induration of the lung, such as that which is produced by very numerous tubercles, or by pneumonia at the period of hepatization, or on a pressing back of its tissue by the interposition of an abundant effusion of serosity, of blood, or of pus: more rarely is it owing to tumors developed in the walls of the thorax, in the pleura, or situated more profoundly, and in contact with the ribs.

As for tumors of the walls, the dull sound teaches only that they are solid or liquid; but palpation and the other methods of examination are indispensable, in order to determine the nature of the dulness. As for tumors more deeply seated, they usually produce a circumscribed dulness, whose seat is by no means fixed. This dulness announces that in the subjacent point there exists a dense and compact body; but this dull sound alone cannot inform us precisely whether there is aneurism or a cancerous tumor, and the aid of other means of exploration becomes necessary.

Is it possible to distinguish whether the dull sound should be attributed to a considera-

ble effusion, or to an induration of the pulmonary parenchyma? In general, in pleural effusion, the dulness is more complete; it usually has its maximum at the base of the chest, and diminishes by little and little, as in percussing we ascend towards the top of the thorax. It stops at a variable distance from the top, at a higher level behind than in front, or, indeed, if it goes as far as the clavicle, this extent itself, approximating to its intensity, becomes an indication of effusion. Another symptom of these considerable collections of liquid, is the pressing back of the heart, which is forced back as far as behind the sternum, and even as far as under the right false ribs, if the effusion takes place in the left pleura. This is not all: in a case of partial effusion, it is sometimes possible, by varying the position of the patient, to produce displacement of the dulness. This mobility of the phenomenon will be, besides, much less apparent in pleurisy than in hydrothorax, an affection in which no false membrane nor adherence prevents the liquid from obeying the laws of gravity.

If, on the contrary, there is induration of the lung, the dulness will be fixed and invariable, whatever be the attitude of the patient.

In general, also, it is less intense, and it is rarely seated in a whole side of the chest; it is oftener limited to a variable extent of the thorax, more decided in one point, and diminishing, if we set out from this centre, in such a way as to be confounded by degrees upon its boundaries with the natural resonance. If the dulness is owing to pulmonary hepatization, it will have its place on one side especially, along the posterior and inferior edge, more rarely at the top, and almost never in front alone.

In cases of tubercles, on the contrary, the dull sound will have its seat at the top, either behind or in front, often on both sides at the same time, and will extend, while diminishing in intensity, even towards the middle part, but scarcely ever so far as the base, unless there be complication of chronic pleurisy.

However, in order to carry on the diagnosis with some certainty, we must not rely alone on the data of percussion; we must bring together with care the results furnished by other methods of examination, and not decide until after having compared them with the functional symptoms, and with indications drawn from the progress of the disease.

C. We have now examined the modifications in degree of the pulmonal sound, either greater or less, but there is another shade of sonorousness, of which we must make mention.

We have seen above, that there is frequently met with at the summit of the chest, in front, a clear and hollow sound, circumscribed to an inconsiderable space, and dependent on the presence of a superficial cavity, which contains only air. Rarely this clear sound is analogous to the truly tympanic sound of pneumothorax; it will not resemble it unless the excavations are very spacious. Much oftener it takes an especial metallic tone, in cases where the cavity contains, at the same time, air and liquid substances (hydro-ærian sound). This sound can be observed again in pneumo-hydrothorax, at the point of contact between the gas and the liquid, and even exceptionally in pleurisy or hydrothorax, either above the level of the effusion, or, according to Mr. Piorry, in the neighborhood of an organ dilated by gases, such as the stomach or the intestines.

Finally, sometimes we produce by percussion of the subclavicular region, a clear sound, accompanied by a peculiar little clap-

ping, whence there results a noise like that which a cracked vase gives out when struck by the finger, and which has taken thence the name of the sound of a cracked vessel (*bruit de pot fêlé*).

In order to display this last phenomenon in a distinct manner, we must generally strike only a single blow, recommending to the patient to hold his mouth open. It announces, in the immense majority of cases, a pulmonary cavity generally tuberculous; but it is not invariably produced, and in order to obtain it, the excavation must have a certain extent; it must be somewhat superficially situated; its walls must be thin and supple, and especially it must contain air and liquid.

Chapter II.—CIRCULATORY APPARATUS.

Percussion of the Heart and the Great Vessels.

§ 1. Especial Rules.

The greater part of the rules that we have drawn out with regard to percussion, applied to the pulmonary apparatus, find their place here also. Generally, a moderate percussion is sufficient to discover the portion of the heart which is in immediate contact with the pec-

toral walls; but to have an idea of the real volume of this viscera, to discover the part hidden under the anterior edge of the left lung, percussion must be more profound, and practised with more force.

The practitioner should always percuss vertically at first, then horizontally; often it is useful to determine more exactly still the limits of the dulness in every direction; and in order to have more exact results, and to be able to judge of the changes which may take place from one day to another, it is well to mark them out with lines by means of the dermographic pencil.

§ 2. Physiological Phenomena.

The præcordial region supplies, in the normal state, an obscure sound whose degree and extent are never absolutely invariable.

In fact, the heart is more or less covered by the anterior edge of the left lung, and these differences necessarily produce great variations in pleximetric results. However, according to the generally received estimates, the normal dulness of the præcordial region is from five to six centimeters in every direction. It begins above, about the fourth rib,

and extends below as far as the sixth; it has its maximum in the centre of this region, and laterally it is confounded by degrees with the pulmonal sound. Below and on the left, it is replaced by the stomachal sound; below and towards the right side, it is often confounded with the dulness of the left edge of the liver, which borders upon the heart, or reaches as far as that organ, in such a way that it is quite difficult to trace exactly the limit which separates these two viscera.

The dulness which is found at the præcordial region by a moderate percussion, does not give (as we have said) the real measure of the dimensions of the heart; it bears relation only to the extent in which the organ immediately touches the walls of the chest. A stronger and more profound percussion is needed to recognize the parts hidden by the lung, and the obscure sound then extends beyond the aforesaid limits, to an extent which varies according to the differences of volume of the heart, in various ages and various individuals.

As for the great vessels taking their rise in the heart, their presence behind the sternum slightly modifies the sonorousness of the chest; and according to the researches of Mr.

Piorry,* it should produce an obscure sound, quite distinct from the pulmonary resonance. This light dulness should exist over a breadth of sixteen to twenty lines, near the base of the heart, where the aorta and pulmonary artery are joined to each other, but will not be more than ten to twelve lines in places where the aorta ascends alone behind the sternal wall.

§ 3. Pathological Phenomena.

The dull sound which the præcordial region gives forth in the normal condition, may, in a morbid state, diminish in intensity and in extent, and even give place to an excess of sonorousness.

Exaggerated resonance is almost always due to emphysema of the internal edge of the lung, which covers the anterior face of the heart; more rarely it coincides with atrophy of this organ, which allows the two lungs to approach each other by their internal edge. Much more rarely yet, the excess of sonorousness depends directly upon a lesion of the

* On the Pleximetric Examination of the Aorta, &c. Arch. Gén. de Méd, December, 1840. (*De l'examen plessimetrique de l'aorte.*)

central organ of circulation, that is, by an accumulation of gas in the pericardial cavity; in fact, pneumopericardium is an entirely exceptional affection. If the sound assumed a hydroaeric tone (*hydroaérique*), it might announce a collection of liquid and of gas in the cavity of the serous membrane.

The changes in sonorousness which are under the influence of pathological conditions of the central circulatory apparatus, consist much oftener in an increase of the natural obscurity of the præcordial region; the latter then changes into a dull sound, both more marked and more extensive, with proportionate increase of resistance to the finger. These phenomena depend either on the presence of voluminous clots in the cavities of the heart, or rather on eccentric hypertrophy of this organ, or on a liquid effusion in the pericardium (hydropericardium, pericarditis), or again on the combination of several of these morbid conditions.

Some peculiar characteristics of the dulness will serve to establish the differential diagnosis.

Thus, in hydropericardium, if the effusion is very abundant, the dull sound will occupy a triangular space, whose base will touch the

diaphragm. Further, the superior level or the lateral limits of the dull sound may sometimes vary with the attitude of the patient; and, for example, when he remains seated, the transverse diameter will exceed the vertical. Let us add that, in hydropericardium, dulness often supervenes, and extends with rapidity. The case is not the same in hypertrophy; the latter develops slowly; the space occupied by the dull sound is usually in proportion to the increase in volume of the heart, and may give the approximate measure of its form, and of its dimensions; we must, however, remember that the complication of pulmonary emphysema, so frequent in organic diseases of the circulatory apparatus, is an obstacle to the exactness of this measurement.

According to Corvisart, and to Mr. Piorry and Messrs. Cammann and Clark (see p. 157), the data furnished by percussion would allow diagnosis to be carried still further, and to distinguish dilatation of the heart with thinning from dilatation with hypertrophy of the walls, as well as to recognize isolated changes in one cavity or another, &c.

In certain cases, a dulness more or less marked, more or less extensive, shows itself

upon the track of the aorta; considered alone, this symptom would be of no great value, because every kind of tumor situated behind the thoracic wall, in the direction of that vessel, would be marked by the same diminution of natural sonorousness. However, an abnormal dulness in the region of the sternum may announce, sooner than any other symptom, the existence of aneurism of the ascending aorta, and the examination of other concomitant phenomena will complete this first semeiotic datum.

Sec. II. Percussion of the Abdomen.

§ 1. Especial Rules.

For the percussion of the abdomen, which is principally practised on the anterior wall, the patient will be placed upon his back, in a symmetrical position, the arms along the body; the thighs, a little raised, will be slightly bent, so that it may be easy to depress the abdominal wall, and thus to come nearer to the profound organs. This moderate relaxation is as much more necessary, as too great a tension of the muscles has the effect of hardening them, and of rendering more ob-

scure the sound furnished by the subjacent viscera.

In order to explore the lateral parts, the patient will lie upon his side, on the one opposite to that which is to be explored; and, for the examinations of the regions of the back he will lie upon his belly, or will keep his seat, the body bent forwards. We shall often make him lean, either to the right, or to the left, in order to see whether these changes of attitude produce displacements in the dulness; and we are rarely obliged, with the same aim, to have the patient put upon all fours.

As for the physician, he will remain standing, on either side, and he will percuss, in different directions, according to the organ which is to be explored. If in the examination of the different regions of the abdomen, digital percussion has the advantage of being immediately allied to palpation, the plexímeter has, in compensation, that of being able to be carried with the greatest facility around the abdominal viscera, in order to measure their circumference; and if, in percussing the chest, the finger generally suffices, here the plate should sometimes be employed in preference. It will be especially useful, if the belly is very sensitive, because

the pressure of the pleximeter, acting with uniformity upon a more extended surface, will be much less painful.

It is over the abdomen especially that percussion ought to be at times very superficial, and at times profound; and the plate will be of use in depressing the abdominal wall, in order to study the sound of the parts deeply situated in the belly.

§ 2. Physiological Phenomena.

The abdomen in its various regions, presents, from the point of view of its normal sonorousness, very great differences, which are in connection with the structure and the very different density of the organs contained in its cavity. In order to study it, we may divide it into three horizontal zones, which include from above downwards: 1st, the epigastric and right and left hypochondriac regions; 2d, the umbilical region and the flanks, which correspond behind to the loins; 3d, the right and left hypogastric and iliac regions.

At the epigastrium, the sound is a little dull at the upper and right portion, over a variable extent, because of the presence of the left

lobe of the liver, which encroaches more or less upon the epigastric hollow. From the rest of this region, which is in relation with the stomach, we obtain a clear sound (*stomachal*) which becomes hydropneumatic (*humorique*) if the stomach contains gases and liquids, and more or less obscure if it is filled with alimentary substances. The right hypochondrium gives out a dull sound (*hepatic*) which extends from below upwards, from the sixth or seventh rib (five inches below the clavicle, according to Mr. Piorry) as far as the edge of the false ribs, beyond which we discover the intestinal sonorousness. This dulness, a little less marked above, in consequence of the habitual interposition of a slight lamina of the lung, is at its maximum at the middle; farther down, the liver diminishing in thickness, we find again, by means of profound percussion, the clear sound of the intestines obscured by the hepatic dulness. Horizontally, the dull sound is prolonged on the right side backwards, and on the left it stops at from three to five centimeters outside of the median line, where it is replaced by the stomachal resonance. These limits, in every direction, give the exact measure of the length and breadth of

the liver; it is even possible, by a strong percussion, to judge approximately of its thickness, and consequently it becomes quite easy to estimate its volume.

On the left hypochondrium, which corresponds to the large extremity of the stomach, there is obtained in front a clear stomachal sound, more marked than at the epigastrium: laterally and farther back, the sound becomes dull, because of the presence of the spleen at this point. The line of separation between the clear sound and the dull sound marks the internal limit of this body, whose lower limit is pointed out by the line where the resistance to the finger gives place to a certain elasticity, and the splenic dulness to the intestinal sonorousness, at least whenever the kidney is not contiguous to the spleen.

The umbilical region furnishes a sound more or less clear, owing to the presence of a portion of the arc of the colon in its upper part, and to the small intestine in the rest of its extent (*intestinal sound*). Laterally, towards the flanks, the sound preserves a little of its clearness, because of the ascending or descending portion of the colon; but more outwardly, and in the whole region of the loins, it gives place to a dull sound on the level of the kid-

neys, which are covered by a thick muscular layer.

At the hypogastrium, the presence of the lowest circumvolutions of the small intestine gives cause to a clear sound if the bladder and the uterus are empty. On the contrary, we obtain, below an invariable dulness, circumscribed by a line curved with the convexity upwards, with hydropneumatic sound (*bruit humorique*) upon the boundary, if it is the bladder that is distended, and immediately replaced by the clear sound if it is the uterus that is developed by the product of conception. Finally, in the iliac regions a clear sound is perceived when the cœcum or the iliac portions of the colon are distended by gases, hydropneumatic if they contain gases and liquids, and dull (stercoral) if they are filled with fæces.

§ 3. Pathological Phenomena.

The sounds given out by the different parts of the abdomen, present, in the pathological state, very numerous phenomena. They may be changed in their intensity and in their character, be modified in their seat and their limits, that is to say, increase or diminish in

extent, and suffer displacements in different ways. Finally, there are manifested at times in different points of the abdomen, anomalous sounds which are not habitually found there, or even of which no trace exists in the healthy condition. Let us study in succession the changes in sonorousness of each of the viscera of the abdomen in particular, and those which may be manifested in different regions of this cavity.

Liver and gall bladder.—The hepatic sound, without changing its character or extent, may be displaced like the liver itself; generally these displacements do not take place except in the vertical direction: the dulness may rise higher than in the natural state, so that its superior limits attain the fourth or even the third rib: this is observed in cases of pressing back of the liver from below upwards, in consequence of an abundant peritoneal effusion, or even in cases of very considerable tympanites. It may also be depressed more or less below the inferior edge of the false ribs by abundant collections of liquids or gases in the right pleura.

In other circumstances, the hepatic sound occupies a more considerable space: its superior limit rises on the side of the chest; at

the same time the inferior limit is depressed many centimeters below the edge of the ribs, and sometimes descends as far as the iliac crest and fossa; often again the dulness extends equally on the left, occupies the entire epigastrium, and even advances into the hypochondrium. We cannot then mistake an augmentation of the liver, the dimensions of which we can measure by that of the discovered dulness, and appreciate the form by the relative increase of the dulness in the vertical or horizontal direction.

But this augmentation in volume of the liver depends on very different lesions: it is due, either to cancerous masses developed in its thickness, to the presence of one or more hydatic cysts, or to a fatty condition, or finally to a recent sanguine congestion, or to chronic hypertrophy without any other change in texture.

In order to fix the differential diagnosis, palpation will often lend useful aid to the pleximeter. In cases of cancer, or hydatic cysts, the parts of the liver which are accessible to the touch present little projections more or less prominent; its inferior edge is also often thickened and unequal. On the contrary, when there is simple hypertrophy,

or the fatty state, the liver habitually preserves its form, the part which goes beyond the false ribs is smooth, and the inferior edge remains thin and sharp. But in hypertrophy the liver is generally heavier and more dense, whilst in the fat state, it is usually lighter; and in the first case, it gives to the finger which percusses a greater resistance than in the second. We must remember besides that the fat state is principally met with in tuberculous phthisis. As for the distinction between cancer and acephalocystic cysts, the cancerous nature of the tumors will be recognized by their number, and by their central depression; we should sooner believe in acephalocysts, if there was only a single tumor more prominent and rounded, and there will, on diagnosis, be no further doubt, if we discover on percussion a peculiar shuddering (*frémissement*), of which we shall speak further on.

At other times the hepatic sound occupies only a contracted space; its dimensions are diminished in all directions, and the limits which circumscribe it are found drawn together from every direction. From these characteristics we must infer a diminution in volume, such as is so often observed in ad-

vanced cirrhosis, and much more rarely in simple atrophy without any other change in texture. These data of percussion are, in such cases, so much more precious, as, because of ascites, a complication so frequent in the before-mentioned lesions, the liver, pressed from below upwards, and entirely hidden under the false ribs, has become quite inaccessible to the touch.

The gall bladder, which normally escapes palpation and pleximetry, may be discovered in certain cases of considerable distension by an accumulation of bile or of mucous liquid, or even by manifold biliary concretions. In percussing along the inferior edge of the liver transversely, we discover at times, instead of the clear sound of the intestines which succeeds the hepatic dulness, a more obscure sound; and if this peculiar dulness is seated at that point of the abdomen which corresponds anatomically to the reservoir of the bile, and if it shows itself of an ovoid form, it is more than probable that it is produced by distension of the gall bladder.

Spleen. The preceding considerations are equally applicable to the spleen.

This viscus may be depressed below its normal position, by a liquid or gaseous effu-

sion of the left pleura, or pressed from below upwards by considerable ascites or tympanites. In the first case, palpation is sufficient sometimes to recognize the position and size of the spleen; but in the second percussion can alone furnish certain data, and the changes of place of which we have just been speaking, are revealed by analogous displacements in the splenic dulness, whilst in the habitual place of the organ, we find an unaccustomed sonorousness.

The dulness of the region of the spleen is also susceptible of variations: usually three and a half inches in vertical extent, and three inches in breadth (according to the researches of Mr. Piorry), it may diminish or increase in a manner more or less noteworthy.

Diminution of extent proceeds most frequently from distension of the stomach, or of the intestines by gases, and then sometimes almost the whole splenic region may produce a clear sound. At other times this diminution is owing to the smaller volume of the spleen; and if we discover this diminution, without there being either tension of the epigastrium and abdomen or exaggerated tympanic sonorousness, we may attribute it

to atrophy of the viscus, such as is frequently met with in patients who yield, in a state of extreme emaciation, to organic diseases of long duration.

But the augmentation in volume of the spleen is a fact which has more importance. When this increase is considerable, the viscus usually passes beyond the inferior edge of the false ribs, and in estimating by palpation the volume of this portion of the spleen, we obtain an approximate idea of its total dimensions; but percussion alone can give us an exact idea of the part hidden by the ribs, and thus concur in revealing its real volume. This is not all: although hypertrophied, the organ may be pressed back, as well as the diaphragm, by gaseous distension of the belly, and in this case, the plexímeter is indispensable in order to determine its dimensions. The measure of the height is the easiest, and in general, in hypertrophy without a lesion, called organic, the increase in breadth and in thickness corresponds to that which takes place in the vertical direction. Now the vertical dulness may rise to five, six, and eight inches, and indicate analogous dimensions in the volume of the spleen. This increase is common after in-

termittent fevers of long duration; in some exceptional cases, it may be still more considerable, since the viscus has been known to measure as much as twelve and fifteen inches vertically, while it weighed eight, ten, or fifteen pounds, and even more.

The increase in extent of the splenic dulness, so frequently connected with hypertrophy of the spleen, may also be met with in other changes, such as cancers, hydatic cysts, &c. But these latter are much more uncommon, and besides the conformation of the viscus, has then undergone changes, more or less remarkable.

Let us add, in conclusion, that it is not always easy to decide whether a dull sound, perceived in the splenic region, is really connected with the spleen; and that it may be difficult to determine its superior limit in cases of hepatization of the base of the left lung, or of pleuritic effusion of the same side, as well as to specify, in ascites, its inferior limits; percussion carried on with different degrees of force while changing the attitude of the patient, will usually avail to triumph over these difficulties.

Stomach.—The clear sound produced by the stomach varies, even in a healthy individual,

in extent and in intensity, according as we explore the organ at a greater or less time after a meal, in a state of emptiness or of fulness of the ventricle. However, in general, this sound is moderately tympanic; it occupies the left part of the epigastrium as well as the corresponding hypochondrium, and it extends a little towards the lower regions of the abdomen.

In consequence of different pathological conditions, the stomachal sound may become much more intense, assume a very decided tympanic character, and, extending farther, rise up in the hypochondrium as far as the fifth rib, fill the whole epigastrium, and descend below the navel. By these characteristics, we recognize an enlargement of the stomach distended by gases, as is frequently observed in cases of contraction of the pylorus (*hydrogaster*). Often, also, the sound assumes a hydropneumatic tone, which announces the simultaneous presence of a great quantity of gas, and of liquid matter accumulated in the cavity of the ventricle.

Finally, in certain cases of dilatation of the stomach, by a considerable mass of changed chymous matter and a smaller quantity of gas, there is obtained by percussion, a pecu-

liar sound of plashing (*clapotement*), produced at the moment when the anterior wall of the ventricle raised up by the gas, is hastily applied to the liquid bed. One of us has twice verified this morbid sound, in patients affected with scirrhous contraction of the pylorus.

At other times, on the contrary, the stomachal sound is much less decided than in the natural state, and circumscribed in narrower limits, where, for example, the stomach is shortened as a result of chronic inflammations, and, above all, by poisoning from acids.

At times, also, it is a dull sound which is found over a certain extent, and principally at the epigastrium and the pyloric region. This dulness of the epigastrium often depends on the presence of the left lobe of the liver, either hypertrophied or naturally lengthened in the transverse direction; but it may also be caused either by cancerous degeneracy of the walls of the stomach, or by an accumulation of blood in its cavity.

In the first case, the dulness is permanent, and by strong and deep percussion we may find the characteristic sound of the stomach under the layer, either more or less thick, of

the liver which covers it. When the dulness depends on a carcinomatous degeneracy, it is usually limited to the pyloric region, where we discover by the touch a movable tumor, whilst the tympanic sound reappears in the left hypochondrium. An accumulation of blood will be recognized, on the contrary, by a dulness supervening in an accidental manner in the course of a chronic affection of the stomach, and during the simultaneous development of the usual symptoms of hemorrhage.

Finally, the displaced stomachal sound may be found again nearer or farther from the seat that it occupies in the normal state; thus we have seen the stomach compromised in hernial tumors of the linea alba, and even of the inguinal ring. Percussion, in drawing from these tumors a clear sound, would reveal the presence of a portion of the digestive tube; and if, after having made the patient swallow a certain quantity of liquid, this sonorousness should be abruptly changed into dulness, it would become incontestable that the stomach itself forms a part of the hernia.

Intestines.—The sound given by the abdomen may become more dull in all the points which correspond to the intestines, or only

over a region, limited as regards these viscera.

Dulness extended to the whole intestinal region often coincides with giving way and retraction of the intestine, and then announces a state of vacuity of this conduit and of contraction of its walls, as we observe in certain cancers of the stomach with repeated vomiting.

Dulness, limited to one portion of the intestine, may be owing to very different pathological conditions. If its appearance, in any point whatever, of the abdomen, coincided with the general symptoms of hæmorrhagia, it might make us admit the accumulation of the sanguineous fluid, and even cause us to suspect the beginning of enterorrhagia. If, verified in the right iliac fossa, it occupied a certain extent, and if there was at the same time *empâtement** and tumefaction of this region, it would be a sign of intestinal obstruction with accumulation of alvine matter, and of alimentary residuum.

In the left iliac fossa, it announces very

* *Empâtement.* A non-inflammatory engorgement, which retains, more or less, the impression of the finger.—*Dunglison's Med. Dict.*

often, the presence of fæces amassed towards the end of the great intestine, in consequence of prolonged constipation.

The dulness may be owing again to carcinomatous degeneracy of the walls of the intestine, or indeed to an intestinal invagination. We should easily suspect the existence of one of these two lesions, if the dulness coincided with a tumor placed on the passage of the ileum.

But cancerous tumors of the small intestine are very rare; the degeneracy most frequently occupies the colon, and the cancer might then be confounded with accumulation of fæces. Its most frequent seat is the left iliac portion; and as this is also the point where the fæcal matters are most frequently collected, there are often in these two morbid conditions, a tumor perceptible to the touch, and hence possibility of an error in diagnosis; this accumulation of fæcal matter might even be taken for an entirely different tumor. But if liquids be then injected into the colon, and percussion be practised again after the injection has operated, if thereupon the dulness disappears, we perceive that there was a fæcal tumor, and if, on the contrary, it remains, we should have to believe in the exis-

tence of a tumor formed by the degeneration of the walls of the intestine, or joined to its surface.

Often it will be useful to associate these injections with pleximetry, not only in order to determine the presence and position of the great intestine, but in order to diagnosticate many of its diseases; they may serve in effect, according to Mr. Piorry, to specify further the existence and the seat of a contraction of the colon which will neither be accessible to the finger nor to probes introduced into the rectum. If, for example, we give an abundant injection, the liquid cannot pass the line of the contraction; and if afterwards percussion produces below a certain point, a dull sound, and above this point a clear sound, there is reason to admit that the contraction is seated at that limit where sonorousness gives place to dulness.

The intestinal sound sometimes becomes more intense, and entirely tympanic. This modification is rarely limited to one part of the abdomen, but usually occupies a great extent of it. It announces the presence of a considerable quantity of gas in the belly: (an excessive quantity, with extreme distension

of the abdomen, would cause, on the contrary, a less degree of sonorousness).

In the immense majority of cases, the elastic fluids are inclosed in the intestine, and constitute intestinal pneumatosis; it is entirely by exception that they are contained in the serous cavity, and form peritoneal pneumatosis. In both cases the tympanic sound is generalized; for the intestines swelled by the gases tend to fill the cavity of the abdomen, and the gaseous effusion in the peritoneum produces a general distension, by means of morbid adherences. However, in meteorism, it is rare for the tympanic sound to have the same intensity at all points; frequently it is more marked at the level of the colon, and often also the intestinal convolutions manifest themselves through the abdominal walls. In true tympanites, on the contrary, the intestines being pressed backwards, the sonorousness will be more uniform. Another characteristic will serve to distinguish the two species of pneumatosis: in intestinal meteorismus, the liver is pushed back towards the thoracic cavity, but it remains in contact with the walls of the hypochondrium, where its presence is revealed by the dulness which is proper to it; whilst in peritoneal tympanites,

it will be pressed at the same time upwards and backwards, and the exaggerated sonorousness will extend even to the hepatic region.

If the tympanic sonorousness of the intestines assumes the hydropneumatic (*humorique*) character, it is an indication of the simultaneous presence of gas and of liquids. Sometimes these fluids are inclosed in two contiguous cavities, and the hydropneumatic sound is then obtained only on the limits which separate the dull sound of the one from the clear sound of the other; it is permanent in the same region, if the liquid is imprisoned in one of the viscera, as when the bladder is distended by urine, and in contact with the intestines swelled by gases; it is, on the contrary, subject to displacements if the liquid itself can be displaced, as we observe in ascites, where the effusion obeys the laws of gravity.

Sometimes the liquids and gases are inclosed in the same cavity, and usually it is the intestine, as we verify in the right iliac region in the greater number of typhoid fevers; in the latter case also, a quick pressure exerted on the corresponding point, causes to be heard

and felt a gurgling, which is not obtained when the two fluids occupy different cavities.

Finally, the intestinal sound, as well as the gastric sound, may be found again at a point more or less removed from the seat which is proper to it. It is especially in cases of hernia of the navel, or of the inguinal region, that we discover these displacements; and percussion, by manifesting the sonorousness of these tumors, proves that they are formed by a portion of the digestive tube. When the hernia is not strangulated, we may sometimes assure ourselves, by means of an injection through the anus, what portion of the intestine it is which is displaced. In fact, if the clear sound continues, this is a symptom that the small intestine is contained in the hernial sac; if the sonorousness is transformed into dulness, this is a proof that there is displacement of the great intestine.

Kidney.—The kidney is so deeply seated behind the anterior abdominal wall, it is placed behind and laterally under so thick a layer of muscle, that it is very difficult to determine by percussion its exact seat and its precise dimensions. Thus pleximetry can scarcely be of use, except to give light to the diagnosis of some of its diseases, such as im-

portant hypertrophies, tuberculous or cancerous degeneration, numerous cysts, hydro-nephrosis, or other changes with remarkable increase in volume of the organ: in these cases, we find a greater and more extended dulness in the flank and the loins of the corresponding side. We have observed one case of this kind, in which the dulness rose as far as the sixth rib, and descended as far as the iliac crest, and the kidney was found degenerated into an encephaloid mass of thirty-five to forty centimeters in length.

Percussion might also cause us to suspect either absence or atrophy of one kidney, or displacements of this viscus, if the region in which it is usually found presented less dulness, and less resistance to the finger. We should conclude that the first of these changes existed, if we could not discover any unusual tumor in the abdomen, and the second, if we verified the existence of a tumor, having nearly the form and volume of the kidney, either in some point of the abdominal cavity, or especially near the sacro-vertebral angle, where we have several times found the organ of urinary secretion.

Bladder.—Situated in the bottom of the small basin, the bladder, when it is empty, is

separated from the abdominal anterior wall by the inferior circumvolutions of the digestive tube, and percussion of the hypogastrium only gives out the clear sound of the intestines.

It is not so when the bladder is distended by urine; its base, mounting into the abdomen, passes the pubis; its anterior face lies close to the abdominal wall at a variable height, and its presence is recognized by a dull sound, circumscribed above by a line bent with the convexity upwards. This phenomenon, which is very easy to prove, becomes a valuable symptom of retention of urine, and the extent of the dulness, whose superior limit rises at times even to the navel, gives us the measure of the quantity of liquid accumulated in the bladder. This dulness is of use in distinguishing retention of urine from suppression, and micturition by redundancy from incontinence. It is equally useful in establishing the diagnosis between tumefaction of the belly, owing to the accumulation of urine in the bladder and the development of the hypogastrium in cases of uterine pneumatosis. At times the distinction will be difficult between retention of urine and several anatomical conditions that also produce a dull sound, such as cysts or other solid tumors of

the hypogastrium, and especially pregnancy and dropsy of the womb. However, in the first case, percussion will give on the superior limit of the dulness a hydropneumatic sound, which will not exist in hydrometra or in pregnancy, and which, for a stronger reason, will be wanting when the development of the uterus depends on other pathological conditions, for example, on solid tumors. Besides, in all these circumstances, resistance to the finger will be greater than in the case of urinous tumor; and if some cysts with very thin walls do not offer this resistance, if we can find a hydropneumatic sound on their edges, we must remember that they rarely occupy a median position, and that they almost never have the fixity of place and the symmetrical form of the distended bladder.

As for ascites, which equally produces dulness in the hypogastric region, we cannot be mistaken in it, by the place which the dull sound occupies, circumscribed by a bent line, with superior concavity, and especially by this decisive characteristic, that it is displaced by changes in position of the trunk.

Uterus.—Hidden in the bottom of the hypogastrium, in the normal state and when it is empty, the womb is inaccessible by palpation

and is completely hidden from percussion. But if it develops itself normally by the presence of an embryo, or pathologically by different morbid conditions, pleximetry will offer data, valuable in diagnosis.

In pregnancy, percussion exercised with care will give from the end of the second month (according to Mr. Piorry) a dull sound, which indicates the development of the uterus. This phenomenon, perceived before we can recognize the increase of the organ by palpation at the hypogastrium, by *ballottement*, and by touch, and before we can perceive by auscultation, the characteristic sounds of pregnancy, will be at this epoch an important symptom, which will add much to the probability of gestation.

But this result, at a period so little advanced, can be obtained only in exceptional cases. Later, as the uterus, increasing in size, passes the pubis and rises into the abdomen, we easily verify at the hypogastrium, by means of percussion, a dulness circumscribed by a bent line with the convexity superior, and whose extent, form, and situation are in relation to the volume, configuration, and symmetrical or inclined position of the matrix. The characteristics of this dul-

ness establish a strong presumption in favor of the existence of pregnancy, but they must not be regarded as certain proof, and they will be insufficient to demonstrate whether the development of the uterus is physiological or pathological; whether it is owing to gestation or to dropsy of the uterine cavity, or to some other morbid production, such as mole, fibrous body, &c.

The presumption of pregnancy would be greater if the progress of the dulness took place with the regularity and measure proper to the state of gestation; but we are not always in a condition to verify this ascending progress, and the semeiotic data of pleximetry are inferior to those that auscultation furnishes at this period. However, according to Mr. Piorry, percussion may facilitate diagnosis, and cause pregnancy to be recognized by several other characteristics of the dulness, such as its greater intensity and more marked resistance to the finger at certain points which correspond to the fœtus, and its less intensity with obscure sensation of fluctuation at intermediate points; finally, by its displacements, owing to changes in position of the fœtus, characteristics which will be

wanting in the before-mentioned pathological conditions.

By giving similar results, pleximetry will be especially useful in establishing the existence of pregnancy in cases where auscultation does not bring to the ear either the sound of the fœtal heart or the placental souffle; and it may, up to a certain point, aid in determining the positions of the fœtus.

In a state of disease, it is almost always by a dull sound also that there are revealed the lesions of which the uterus may be the seat. Thus, in cases of dropsy, of considerable internal hemorrhage, or of fibrous bodies of great volume, percussion displays a dulness whose extent gives the measure of the development of the womb or the dimensions of the tumor. Some especial characteristics may, besides, serve to give precision to the diagnosis; thus, in dropsy or in internal hemorrhage, the dull sound is everywhere equal and without remarkable resistance to the finger, and the space that it occupies is regularly ovoid like the uterus itself, whilst in the case of fibrous bodies there is not an intensity everywhere uniform; some of the points of the organ offer to the finger a resistance more or less great, and, besides, the form of the space

occupied by the dulness is very irregularly rounded.

It is only in infinitely rare circumstances that the uterus can send forth a tympanic sound; a considerable accumulation of gas in its cavity is alone capable of producing this phenomenon. However, this case has sometimes been observed, and uterine tympanites would probably exist, if we found at the hypogastrium an ovoid tumefaction giving a clear sound, circumscribed in every direction, and invariable in position.

As for the appendages of the uterus, their most common lesions, capable of affecting the sonorousness of the abdomen, are cysts of the ovary and of the Fallopian tubes, producing a dull sound, that is usually found on one side or the other of the hypogastrium, and which very rarely assumes a symmetrical position in the median region. The dulness will be as much more decided, and accompanied by a resistance as much greater as the walls of these abscesses are thicker, and as the parts contained have more consistence. The extent of this dulness will give, in concurrence with palpation, the approximate measure of the volume of the tumors. As long as they are only of middling dimensions,

the cysts of the ovary and of the tube will not be confounded with ascites; but the case is different when they fill the whole abdominal cavity. Farther on we shall give the different characteristics of the dull sound in both of these diseases (p. 148).

Peritoneum and abdomen in general.—After having studied especially the changes of sonorousness belonging to the principal viscera of the abdomen, there remain to be specified those which may occupy the whole extent of this cavity, and those which, although localized, may be found indifferently in various regions of the abdomen.

We have seen before (pp. 136 and 137) that in peritoneal pneumatosis, we obtain, by percussion, a clear sound, a tympanic resonance, which extends, more or less uniformly, over the whole anterior abdominal surface.

At other times, and much more frequently, the abdomen gives out, in its whole extent, a more obscure sound; this is observed in cases of serous infiltration of the abdominal walls, and in those of obesity with thickening of the subcutaneous adipose bed, and fatty infiltration of the folds of the peritoneum and of the deep cellular tissue.

At times also the whole part which corres-

ponds to the intestines gives an obscure sound in chronic peritonitis, when false membranes exist, thick and infiltrated with tubercles, with or without tuberculous degeneracy of the mesenteric ganglions, and in these cases, palpation is useful in completing the indications of pleximetry.

At other times, percussion points out a dulness limited to some point or other of the abdomen. It may be owing to a tumor developed in one of the organs of which we have already spoken; or depend on a puriform collection, circumscribed in the serous cavity, on peri-uterine hæmatocele, on a hydatic cyst, on cancer of the epiploon, or on extra-peritoneal abscess of the cellular tissue, as is frequently observed in the iliac fossæ and in the small basin.

The degree and the extent of the dulness will usually give the measure of the density and of the volume of these solid or liquid tumors, and its seat will sometimes enable us to infer the seat and the nature of the lesion; but, in general, the results of percussion will not be sufficient for the diagnosis, and in order to arrive at an exact knowledge of the changes, we must add to the pleximetric indications, the data furnished by palpation of

the abdomen, and by the vaginal or rectal touch, and must keep an account equally of the presence, and of the progress of the concomitant symptoms.

Diagnosis will be possible by the aid of percussion alone, when the dulness, instead of being limited to a circumscribed region, occupies the whole declining portion of the abdomen, and especially when at the same time it is liable to be displaced by changes in the position of the patient: these characteristics are sufficient to make us recognize ascites.

The existence of a liquid effusion in the peritoneum would be still more positive, if we obtained, by percussing, a hydropneumatic sound on the limits of the dulness, or if there was perceived an evident fluctuation.

There are cases where the dulness occupies the whole, or almost the whole of the abdomen, which presents at the same time a very great volume. We may then diagnosticate almost with certainty the existence of ascites or of considerable ovarian dropsy. The distinction will be established by the following characteristics: in encysted dropsy, the dulness occupies the most prominent region of the distended belly, whilst the clear sound is found again at the sides, where the intestines

are pushed back by the tumor. In ascites, on the contrary, the dull sound occupies all the declining part, whilst in the region above the navel the presence of the intestines, pressed back towards the epigastrium and floating on the surface of the liquid, produces a tympanic sound, which contrasts with the dulness of the rest of the abdomen, whence it is separated by a curved line, with the concavity superior. Besides, the fluctuation is much more decided in ascites than in encysted dropsy of the ovary.

Besides the different modifications of sonorousness hitherto described, there is one that is most frequently discovered in the abdomen, but which may be met with in very different regions of the trunk and of the members.

It is a peculiar sound, or rather a mixed phenomenon, obtained by percussion, and resulting from the association of a kind of hydropneumatic (*humorique*) sound with a vibratory shuddering, perceived by the hand, and designated by the name of watery sound or shuddering (*bruit ou frémissement hydatique*). This phenomenon, of which an exact idea can be obtained by shaking in the palm of the hand an acephalocyst, is actually connected

with the existence of hydatids, and depends on the oscillation of these vesicles in the sac which contains them. This shuddering does not take place in all hydatid tumors, therefore its absence will not prove that a spheroid tumor of the region of the liver is not an acephalocystic cyst; but its presence constitutes a pathognomonic symptom of this kind of disease.

Sec. III.—Percussion of the Head, the Neck, the Spine, and the Members.

Among the facts of pleximetry can we place the pretended sound of a broken vessel, that the cranium is said to yield on percussion, in cases of fracture; the particular sound that is given by a carious tooth when struck by a stylet; the dulness with fluctuation that is found on articulations which are the seat of hydrarthrus; &c.?

Percussion may have applications more real and more useful in cases of fistulous abscess, containing gases or air; at times also it will be of use in the differential diagnosis of anasarca, and of emphysema of the cellular tissue, in displaying in the first disease a note-

worthy dulness, and in the second a sonorousness accompanied by a dry crepitation under the pressure of the finger.

Mr. Piorry has also proposed to percuss upon the vertebral column, or upon the spinal regions in order to discover either aneurisms of the descending aorta, or deviations and changes in volume of the vertebræ, or abscesses developed in their neighborhood, consecutively to caries. In all these cases it is a dull sound that is proved on percussion, and the extent and form of this dulness indicate the volume and form of these changes.

Finally, Mr. Stokes, of Dublin, has advanced the idea that percussion cannot be without utility in diagnosis of diseases of the larynx.* But, before him, Mr. Piorry had already pointed out all the opinions relative to this subject:† "Percussion of the larynx or of the trachea can hardly be made, except mediately. In order to practise it, we must fix the trachea and the larynx, by the aid of the pleximeter, quite strongly applied to these conduits. In the normal state, the finger finds elasticity, and the ear hears sonorous-

* A Treatise on the Diagnosis and Treatment of Diseases of the Chest, 1837.

† Treatise on Diagnosis, v. i, p. 412. (*Traité de Diagnostic.*)

ness upon the points which correspond to these organs. There are very few pathological cases where it will be otherwise; only, if it should happen that a tumor having its seat on the neck surrounded the trachea and the larynx, we might make use of percussion in order to determine the place that they should occupy. The presence of liquids in the ventricles of the larynx might sometimes produce the hydropneumatic sound. The accidental opening of the larynx, followed by the penetration of air into the neighboring cellular tissue, might be suspected if percussion discovered at the neck an unaccustomed sonorousness in connection with emphysema. In case of a soft and depressible tumor, situated upon the larynx, we might judge of the depth at which this is situated, by that at which we should obtain sonorousness in pressing upon the tumor with the plexiimeter and in percussing afterwards."

Percussion and Auscultation Combined.

Laennec had the idea of combining auscultation and percussion; he had proposed the simultaneous employment of these two modes

of examination in certain cases of ascites and of pneumothorax;* to these we usually have recourse in order to make known and better to perceive the hydatic sound (*bruit hydatique*). Two physicians of the United States, Messrs. Cammann and Clark, have gone farther: they have generalized this mixed method;† they have traced its rules, and exposed its advantages in physical diagnosis. We propose to give a summary analysis of their work:‡ "When a sound is obtained by ordinary percussion on the human body, a thousand parts are dispersed and lost for one which comes to the ear; but if we could receive the sonorous vibrations at the end of a solid, elastic,

* "We may," says he, "estimate the extent of space occupied by the air in auscultating and percussing at the same time at different points; there is then heard a resonance like that of an empty cask, and mingled at times with tinkling" (*tintement*). (Vol. i, p. 139.) Mr. Piorry likewise indicated in 1826 (Treatise on Mediate Percussion, p. 18, and Operation of Percussion, p 26), the combined use of percussion and of auscultation; Mr. Donné pointed it out under the name of *acouophonie;* and Mr. Fournet, who reports the fact in his Clinic Researches (p. 561), says that he tried this mode of investigation without having been able to make any useful application of it.

† A New Mode of Ascertaining the Dimensions, Form, and Condition of Internal Organs, by Percussion and Auscultation. (New York Journ. of Med. and Surg., July, 1840.)

‡ See the detailed analysis and the experiments made by one of us. (Medical Union, 1850.) (*Union Medicale.*)

homogeneous body, very little would be lost by irradiation, and almost all would be perceived at the other end. Although the vibrations be thus conducted through a small surface, the sound gains much in clearness and in intensity."

Setting out from this principle, the American physicians propose, for auscultation, to use, in place of the ordinary stethoscope, a solid cylinder of cedar wood, cut in the direction of the ligneous fibres, five or six inches long, and about ten lines in diameter, furnished with a plate on which the ear rests.* For percussion, the pleximeter is employed. The operator may proceed thus in auscultatory percussion: let the cylinder be placed over the central part of the organ to be explored, and let one observer auscultate while another percusses, with very light blows, with a single finger. Messrs. Cammann and Clark also observe that with a little exercise it is possible for the same individual to percuss and

* The cylinder ought to pass a little beyond the level of the plate, in order to be applied directly to the tube of the ear; without change of medium (a solid cylinder with a smooth plate, all of the same piece, has appeared preferable to us). We may make use, for auscultation of the chest, of an instrument cut at an angle at its lower part, which depresses better the intercostal spaces without touching the ribs.

auscultate at once. Whatever method be employed, we strike at first some blows upon the pleximeter, quite near to the stethoscope, in order to have the representative sound (*son typè*) of the viscera; we then remove by degrees until other mediums give sounds entirely different. If we wish to verify this first result, there is an advantage in setting out, on the contrary, from a point of the circumference and approaching the centre: besides, care must be taken to mark in succession the points where the sound appears more or less to vary.

The American physicians have established typical sounds (*sons types*), to which others may be compared; at the extremes of the scale they have placed the sound given by a bone and that supplied by a liquid contained in the thorax or abdomen.

"The osseous sound is most easily distinguished from the others; its tone is very elevated, very intense; it strikes the ear with a painful force; it is full and loud, and is propagated to a great distance; it is a little prolonged and slightly metallic.

"The aqueous sound is very imperfectly transmitted through the abdominal or thoracic walls, it is rather recognized by its nega-

tive properties; in the abdomen it is rapid, as if under the ear, acute, of a medium intensity, non-elastic, much less conductible, and less impulsive than the osseous sound."

In the thorax, this aqueous sound has characteristics still less distinct; it entirely resembles that of the healthy lung: hence the facility of distinguishing a solid or indurated organ from a liquid contained in the chest.

"The cardiac sound approaches the osseous sound; it has its acuteness, clearness, and conductibility, but to a less degree; it is rapid, immediate, intense, impulsive, and a little painful to the ear; it has, principally at the circumference of the heart, as it were a muffled metallic tone.

"The hepatic sound, compared to the cardiac, is graver, more continuous, less freely conducted by the organ where it is formed; but it is clear, intense, immediate, and impulsive.

"The normal pulmonary sound, and that of pneumothorax or of abdominal pneumatosis, differ from the preceding; but for these cases, ordinary percussion is preferable, the sonorous vibrations being then better conducted by the air than by a solid medium."

With the new method, it should be possible

to bound and to measure solid organs, "in all conditions of health or of disease, with almost as much exactness as if they were under the eye," either the heart (and all its diameters, except the antero-posterior), or the liver, or yet the spleen or even the kidneys.

It is especially to the measurement of the heart, that Messrs. Cammann and Clark applied themselves; they recommend it to be drawn by means of four diameters, which they trace upon the præcordial region,* and of eight points at a nearly equal distance, which they mark upon the circumference of the organ; and these traced diameters are measured by turns, are compared to the normal mean, either isolated or reunited, and from the sum of the lengths can be specified the dimensions of the heart, and the augmentation of its volume rigorously calculated.

* 1st. Vertical diameter; begins at the base of the heart, just outside of the orifice of the aorta, and extends downwards in a parallel line with the median line of the body. 2d. Transverse diameter; cuts the first line at a right angle near its centre. 3d. Oblique right diameter; from the superior right edge of the right auricle to the point of the heart, following a line drawn from the top of the right shoulder. 4th. Oblique left diameter; cuts the line of the oblique right diameter at a right angle, and finishes at the point where the left auricle and the left ventricle unite.

The normal mean of these four united diameters being found upon the dead body, to be 17 inches in man, and 16 inches, 1 line in woman, the result is, according to the authors of auscultatory percussion, that if the sum of the diameters calculated by their method, exceeds these means, if especially it rises above 17 inches, we must conclude that the heart is augmented in volume. If it equals 18 inches, 8 lines, the existence of an organic affection with dilatation is almost certain; whilst if the total of the diameters is inferior to the fore-mentioned means, it is not probable that there is enlargement in the dimensions of the heart.

The application of percussion and of auscultation combined, has also been made to the diagnosis of some surgical lesions of the osseous system, principally of fractures.

When a bone is broken, if we auscultate upon one of the broken parts, percussion being practised upon the other, the osseous sound whose characteristics have already been specified, is transmitted to the ear modified in its nature; it is less pure and less perfect. If the broken parts are still touching each other, even by a single point, the sound will be less intense and less impulsive, the modification

being, however, very slight; but let the least separation exist, the sound and the shock will be immediately lost.

The mixed method of percussion and of auscultation may bring about new progress in physical diagnosis, and it is to be desired that observers should study it seriously, in order to give a rational decision as to its definite value. From the experiments that we have made, we are disposed to admit that it may, in effect, be of use in limiting solid organs. It is in measuring the heart that it has seemed to us that it must be most useful. As the smallest permanent changes in the volume of this viscera are of great semeiotic value, it follows that a rigorous estimation of its dimensions, and an exact drawing of its different cavities, is a problem as important as it is difficult to solve, and we believe that by the new operation, a singularly exact measurement of the heart may be obtained. After a certain number of experiments, we were able without great effort to discover the limits of the organ with an exactness at times surprising, and to distinguish the point of origin of the great vessels or the

line of separation of the ventricles and auricles.

But whatever may be said by Messrs. Cammann and Clark, and in spite of the authority of the physicians of America,* the manual of operation has appeared to us to present some difficulty. If, indeed, we make use of an assistant in percussing (according to the method indicated in the memoir of the inventors), how many inconveniences there are, in clinic and especially in civil practice, in a method of examination which demands the simultaneous co-operation of two observers. Then if one person endeavors to auscultate himself and to percuss at the same time (as the American physicians now do, and as we have endeavored to do ourselves), he is certainly incommoded in this double operation. Is it easy to percuss, when it is necessary to fix the stethoscope with the head upon the chest or the abdomen of the patient? Is it easy in this posture to carry the pleximeter around the cylinder in every direction, and to move

* We are informed by our honorable associate and friend, Dr. Keene, that the new method is preferred in the New York hospitals, principally for measuring the heart, and that it is always practised by a single observer.

it sometimes only a few lines, sometimes to a considerable distance? Finally, this rather laborious and necessarily prolonged exploration does it not exact from the patient a good-will and a co-operation which are wanting in many cases?

To sum up: auscultatory percussion appears to us difficult of execution; its profound study must demand at least as much time as ordinary percussion; if it can rival the latter in measuring solid or indurated organs, even if it allows us perhaps to appreciate more exactly the precise dimensions of the heart, it is certainly inferior in the majority of cases, and especially in examining the rarer mediums.

Besides, ordinary percussion and isolated auscultation, if the finger and the ear be sufficiently exercised, appear to suffice for all the exigencies of diagnosis.

LIBRARY OF CONGRESS
0 029 827 886 8